



Project
Manual for

2024 Cy Ridge HS Renovation

RFP# 24-02-5752-R-RFP

Cypress-Fairbanks Independent School District

ISSUE FOR PROPOSALS

December 9, 2024
Page Project No.: 33AC23221

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2024 Cy Ridge HS Renovation

Architect – Page

1100 Louisiana, Suite One
Houston, TX 77002
Tel: 713-871-8484
Contact: Wendy Heger, AIA.
Email: wheger@pagethink.com

Consultants

Associate Architect – HarrisonKornberg Architects

3800 Buffalo Speedway, Suite 550
Houston, TX 77098
Tel: 713-229-0688
Contact: James Harrison, RA.
Email: jharrison@harrisonkornberg.com

MEPT Engineer - Salas O'Brien

10930 W. Sam Houston Pkwy. N., Suite
900 Houston, TX 77064
Tel: 281-664-1900
Contact: Brad Kalmans, P. E.
Email: brad.kalmans@salasobrien.com

Civil Engineer - Brooks & Sparks, Inc.

21020 Park Row
Katy, TX 77449
Tel: 281-578-9595
Contact: James A. Eggleton
Email: jime@brooksandsparks.com

Structural Engineer – Dally + Associates, Inc.

9800 Richmond Avenue, Suite 460
Houston, Texas 77042
Tel: 713-252-3722.
Contact: Fred Dally
Email: Fred Dally fdally@dallyassociates.com

Professional Seals

2024 Cy Ridge HS Renovation

RFP# 24-02-5752-R-RFP

Cypress-Fairbanks Independent School District

ISSUE FOR PROPOSAL

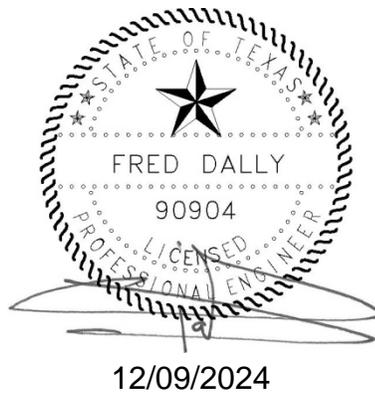
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Architect



Structural Engineer



Civil Engineer



Plumb/Mech
Engineer



Electrical Engineer



Technology



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DOCUMENT AA

REQUEST FOR COMPETITIVE SEALED PROPOSALS

Competitive Sealed Proposals for the work described below in accordance with Proposal Documents and addenda as may be issued prior to date of proposal opening will be received by the Board of Trustees, Cypress-Fairbanks Independent School District, until proposal closing date and time, as identified below. Proposals from Offerors will then be opened in public and read aloud.

OWNER: Cypress-Fairbanks Independent School District
11440 Matzke Rd.
Cypress, Texas 77429
Representative: Mr. Jesse Clayburn, Assistant Supt. of Facilities and Construction

ARCHITECT: Page Architects
1100 Louisiana Street, Suite One
Houston, Texas 77002

PROJECT: **2024 Cy Ridge HS Renovation**
CFISD Proposal Number: 24-02-5752R-RFP

LOCATION: **7900 N. Eldridge Pkwy., Houston, Texas 77041**

PROPOSED CONSTRUCTION BUDGET: **\$29,013,973.22**

PRE-PROPOSAL CONFERENCE: **Monday, December 16, 2024, at 2:00 PM** at Cypress-Fairbanks Independent School District, Facilities & Construction Conference Room, 11430-B Perry Road, Houston, Texas 77064. Representatives of the Architect and Owner will be present at this meeting. All offerors are encouraged to attend.

PROPOSAL DATE AND TIME: **Tuesday, January 7, 2025** Base Proposal: 2:00 PM
Alternate Proposal: 3:00 PM

LOCATION OF PROPOSAL OPENING: Cypress-Fairbanks Independent School District
Facilities and Construction
11430-B Perry Road
Houston, Texas 77064
(281) 897-4108

Proposal Documents will be available on/after **Monday, December 9, 2024**. General Contractor Offerors may obtain two (2) sets of drawings and specifications at the place identified below upon deposit of **\$100.00** per set with check made payable to **Page Architects**. The deposit will be returned when the Plans and Specifications are returned in good condition. Additionally, General Contractor Offerors must submit of a fully executed AIA Document A305, Contractor's Qualification Statement to the office of the Architect at the time proposal documents are obtained.

In addition, proposal documents can be reviewed at the following locations:

ISqFt Plan Room (AGC)
8450 Westpark, Ste. 100
Houston, Texas 77063
Ph: (713) 843-3700 Fx: (713) 843-3701

McGraw-Hill Construction/ Dodge Data & Analytics
www.dodgeplans.construction.com or contact Toni.Lawson@construction.com Ph: (281) 460-5730

Office of **Page Architects**

FULL REFUND: Deposits will be returned provided all Contract Documents and addenda are returned to the Architect complete with all sheets bound in their original order within ten (10) days of the opening of proposals.

FORFEIT OF DEPOSIT: When the Documents are not returned under the conditions specified, none of the deposit will be returned. However, the Documents shall remain the property of the Owner and must be returned.

All proposals must be in the hands of the Owner no later than the time specified above. Please seal all proposals in duplicate in an envelope with the following information on the face of the envelope.

Name of Offeror (General Contractor)
2024 Cy Ridge HS Renovation
Cypress Fairbanks Independent School District
Cypress-Fairbanks I.S.D. Proposal Number: **24-02-5752R-RFP**
_____(Name of Bonding Company)
Attn: Mr. Jesse Clayburn, Assistant Supt. of Facilities and Construction

The Owner reserves the right to reject any and all proposals and to waive any informality in the Competitive Sealed Proposal process. No proposal shall be withdrawn within sixty (60) days after the proposal opening without the specific consent of the Owner. Refer to Offerors Section Document AB.

SELECTION CRITERIA: Selection criteria are included in Document AB of the Project Manual and Selection Criteria and are available on request by perspective Offerors from the office of the Architect.

PROPOSAL BOND: A Proposal Bond from a bonding company acceptable to the Owner or a certified check in an amount equal to 10% of the greatest amount proposed must accompany each offeror's proposal.

PAYMENT BOND AND PERFORMANCE BOND: A Payment Bond and Performance Bond, each in an amount equal to 100% of the Contract Sum conditioned upon the faithful performance of the Contract will be required. Refer to Section AB, Instructions to Offerors for detailed Bond requirements.

The prevailing rates of wages as stipulated in the Supplementary Conditions here within are the minimums that must be paid in conformance with all applicable laws of the State of Texas.

All Offerors (General Contractors) submitting proposals are encouraged to attend the proposal opening and visit the Project site.

Subcontractors and Suppliers intending to submit proposals to General Construction Offerors are required to prepare their proposals based on a complete set of proposal documents. If after reviewing the complete set of proposal documents, Subcontractors and Supplier Offerors desire to purchase individual drawings and specification sections for their proposal convenience, they may do so by ordering the specific drawings and specifications directly from the reproduction company. Each offeror purchasing a partial set of proposal documents is responsible for determining exactly which documents he requires and is responsible for all costs associated with printing and delivery. Subcontractors and Suppliers exercising this option must agree to do so on the basis that 1) all documents shall be returned to the Architect, without refund, after submitting a proposal and 2) documents shall not be used on other construction projects. Successful Subcontractors and Supplier Offerors may retain their Proposal Documents until completion of the construction. The subcontractor/supplier is responsible for all the associated work and coordination when not obtaining a complete set of drawings.

END OF DOCUMENT

DOCUMENT AB

INSTRUCTIONS TO OFFERORS

1. QUALIFIED OFFERORS

- A. Proposals will be accepted from qualified General Contractors only for the entire scope of work described in the Contract Documents. As a prerequisite to a Contractor's qualifying for the award of contract on this work, the Contractor must complete each item of the Contractor Information and Experience Statement (AIA Document A305TM). The Statement forms may be obtained from the office of the Houston Chapter of the American Institute of Architects (A.I.A), 315 Capitol, Suite 120; Houston, TX 77002. The Statement and 3 references of similar projects with current/verified phone numbers, email address and current/verified fax numbers for references of Owner and Architect (refer to Exhibit A on page 9), shall be submitted to the Architect by **5:00P.M. CST on Tuesday, December 24, 2024**.
- B. Every interested Offeror shall be required to submit AIA Document A305TM (Contractor's Information and Experience Statement) to Architect. AIA Documents submitted by fax transmission will not be accepted.
- C. The primary purposes of the evaluation process will be to:
 - 1. Gather information for the Owner's evaluation procedure.
 - 2. Enable the Architect to evaluate the Contractor's qualifications and determine which Contractors the Architect could recommend to the Owner should such recommendation be requested by the Owner.
- D. After completion of the Contractor evaluation process, the Architect will notify the Owner and each Contractor who has submitted a Contractor's Qualification Statement as to the Architect's opinion. In the event the Owner chooses to determine the acceptability of Contractors prior to receipt of Proposals, the Contractors will be notified of the Owner's decision prior to the proposal date, otherwise the Owner will make his decision after receipt of proposals.
- E. In arriving at his opinion concerning the Contractor's qualifications, the Architect will use the same criteria that the Owner will use in determination of the successful Contractor as detailed hereinafter.
- F. In the event an Offeror fails to submit the specified Contractor's Qualification Statement in accordance with the schedule established, such noncompliance shall be considered by both the Owner and Architect as a negative factor in the determination of the successful Offeror.
- G. In the event the Architect notifies a Contractor that it is the Architect's opinion the Contractor has not sufficiently demonstrated his qualifications to perform the subject Contract, taking into consideration the items listed under Paragraph 19.A and the Contractor subsequently decides to submit a Proposal, the Contractor shall be doing so with the knowledge that the Architect will not recommend him as a qualified Offeror.

2. OFFEROR'S PRESENTATION

Each Offeror by making their Proposal represents that:

- A. The Offeror has read and understands the Proposal Documents and their Proposal is made in accordance therewith.
- B. The Offeror has visited the site, has familiarized themselves with the local conditions under which the work is to be performed and has correlated their observations with the requirements of the proposed Contract Documents.

- C. The Offeror agrees to comply with the requirements of the following paragraph. These requirements are absolute, and any Offeror who subsequently does not agree to comply with these requirements will automatically disqualify himself from proposing or receiving award of the contract.

- D. The Offeror agrees that:
 - 1. Work on the project will begin immediately upon the General Contractor's receipt of CFISD's Notice to Proceed. The NTP will be accompanied by CFISD's purchase order.
 - 2. On-site mobilization will not begin until after the Bonds and Certificate of Insurance have been reviewed and approved by the Owner and that timely submittal of correct Bonds and Certificate of Insurance is solely the responsibility of Offeror.
 - 3. Offeror will participate as a team member in cooperation with the Owner and Architect.
 - 4. The Offeror will assign competent full-time superintendents and that these superintendents shall be maintained on the project for the duration of the project including completion of all punch list items, subject only to their continuous employment.
 - 5. The Offeror will furnish and pay for a proposal bond in the amount of ten percent (10%) of the greatest amount proposed.
 - 6. If awarded, the Offeror shall furnish and pay for a Performance Bond and a Payment Bond each in the full contract amount.
 - 7. Offeror and its subcontractors shall comply with requirements listed in Document BD, Insurance and Bonds Requirements for Contractors and Facility Renters.
 - 8. Each Offeror by making their Proposal represents that their Proposal includes only material and equipment specified in the Proposal Documents and supplemented, if necessary, for a complete and operating system.
 - 9. Each Offeror by making their Proposal represents that their Proposal includes the employment of Subcontractors that meet or exceed the Installer Qualifications described in the Project Manual.
 - 10. Each Offeror (and sub-Offeror or supplier submitting a proposal to an Offeror) shall submit an affidavit stating that no asbestos, PCBs or lead building materials will be incorporated into the Work.

3. PROPOSAL DOCUMENTS

- A. Proposal Documents include the Proposal Forms, Contract Forms, Specifications, Drawings, Addenda and documentation as noted in AIA Document A201TM-2017, as amended.

4. INTERPRETATION OF PROPOSAL DOCUMENTS

- A. Offerors and sub-Offerors requiring clarification or interpretation of the Proposal Documents shall make a written request using the form bound in the Project Manual, which shall reach the Architect at least ten (10) days prior to the date for receipt of proposals.
- B. Any interpretation, correction or change of the Proposal Documents will be made by Addendum. Interpretations, corrections or changes of the Proposal Documents made in any other manner will not be binding.

5. SUBSTITUTIONS OF MATERIALS AND EQUIPMENT

- A. The materials, products and equipment 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 ten (10) 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. No substitutions will be considered after the Contract award.

6. ASBESTOS, LEAD AND PCB CONTAINING MATERIALS, PRODUCTS AND SYSTEMS

- A. The use of asbestos or PCB's in any construction process is strictly prohibited
- B. Prior to submitting a proposal, Offerors shall notify the Architect, in writing, of any materials, products and systems in these specifications which are known to contain or are likely to contain asbestos, lead or PCBs. The Architect will promptly explore possibilities for selecting other materials, products and systems which would circumvent the problem and notify Offerors of any changes in an addendum, otherwise it will be understood that only specified materials, products and systems that are asbestos, lead, and PCB free are included in the proposals.
- C. Prior to payment of Retainage and Final Payment, the Contractor and all subcontractors shall furnish a notarized statement certifying that no asbestos/PCB's, or asbestos/PCB-containing materials have been used in this Project.

7. INSURANCE

- A. Each Offeror shall include in his proposal the complete cost for insurance required under the Amended General Conditions, Supplementary Conditions and Specification Document BD, Insurance and Bond Requirements for Contractors and Facility Renters. Coverage shall remain in full force for the duration of the Project.

8. PERFORMANCE BOND AND PAYMENT BOND

- A. Each Offeror shall include in his base proposal, the premium costs for 100% Performance Bond and 100% Payment Bond. Bonds shall be written by a Surety Company included in the latest State Board of Insurance, Bond Department's "List of Insurance Companies Licensed to Write Fidelity and Surety Bonds in Texas, and the latest United States Department of the Treasury's Listing of Approved Sureties (Department Circular 570). The Owner reserves the right to make inquiries about the current financial stability of the Surety, including demands for proof of sound reinsurance, proof that claims are being met, and current financial information. The Owner reserves the right to reject Bonds written by a Surety that, in the Owner's judgment, does not provide proof of sound reinsurance and or does not provide proof that claims are being met.

9. PROPOSAL PROCEDURES

- A. A proposal is invalid if it has not been received at the designated location prior to the time and date for receipt of proposals indicated in the Request for Competitive Sealed Proposals, or prior to any extension thereof issued to the Offerors by Addenda.
- B. All requested Alternates shall be proposed. If no change in the Base Proposal is required, enter "No Change".

- C. Prior to the receipt of Proposals, Addenda will be transmitted to each person or firm recorded by the Architect as having received the proposal documents in accordance with the Request for Competitive Sealed Proposals, and will be available for inspection wherever the proposal documents are available for that purpose.
- D. Proposals must be submitted in duplicate and only on the Proposal Forms included in the Project Manual, in sealed envelopes addressed as follows:

Name of Offeror (General Contractor)
Competitive Sealed proposal for:
2024 Cy Ridge HS Renovation
Cypress-Fairbanks Independent School District
Cypress-Fairbanks ISD Proposal Number: 24-02-5752R-RFP

Name of Bonding Company
Attn: Mr. Jesse Clayburn, Assistant Supt. of Facilities and Construction
Facilities, Planning & Construction
11430-B Perry Road
Houston, Texas 77064

- E. All proposals must be delivered sealed to the above address stipulated in the Request for Competitive Sealed Proposals at or before the time and date set. Proposals will be received at no other place. If Proposal is sent by U.S. Mail, it must be sent Registered Mail.
- F. The Owner reserves the right to reject any Proposal if the evidence submitted by, or investigation of, such Offeror fails to satisfy the Owner that such Offeror is properly qualified to carry out the obligations of the contract and to complete the work therein. Conditional proposals will not be accepted. Award may be made to other than the low-dollar Offeror and given to the one offering the “best value” to the school district, in addition to the purchase price, based on the published selection criteria and on its ranking evaluation.
- G. A proposal may be withdrawn only upon request by the Offeror or his duly authorized representative, provided such written request is received by the Owner at the place designated for receipt of proposals and prior at least forty-eight (48) hours before the time fixed for the opening of proposals. The Proposal Bond will be returned with the proposals if withdrawn in accordance with the above. The withdrawal of a proposal does not prejudice the right of the Offeror to file a new proposal at the time and place stated. No proposal may be withdrawn after the time fixed for the opening of proposals for a period of sixty (60) days.

10. SUBMISSION OF ADDITIONAL PROPOSAL INFORMATION

- A. The Offeror shall submit with his Alternate Proposals:
 - 01 Proposal Form AC Alternates
 - 02 An experience profile (resume) of the proposed superintendent(s) and project manager(s). These experience profiles will be considered by the Selection Committee in the evaluation of the Offeror’s proposal.
 - 03 The firm names of the major subcontractors and/or suppliers requested on the Alternate Proposal Form AF.
 - 04 Signed and Notarized Special Owner Requirements Sections 01 35 23 and 01 35 23.1.
 - 05 An experience profile (resume) of the Offeror, including a list of projects completed of similar size and scope. These experience profiles will be considered by the Selection Committee in the evaluation of the Offeror’s proposal.

11. FELONY CONVICTION NOTIFICATION

- A. Each Offeror shall execute and submit Form AE, Statement of Affirmation within the sealed envelope containing the Base Proposal.

- B. Section 44.034, of the Texas Education Code requires 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.” Subsection (c) states “this section does not apply to a publicly held corporation”.

12. PROPOSAL EVALUATION WAIVER

- A. Each Offeror shall execute and submit Form AG, Proposal Evaluation Waiver within the sealed envelope containing the Base Proposal.
- B. All Offerors shall agree to waive any claim it has or may have against the Owner, Architect, Engineers, Consultants and their respective employees, arising out of or in connection with the administration, evaluation, or recommendation of any proposal. The Offeror further agrees the Owner reserves the right to waive any requirements under the proposal documents or the Contract Documents, with regards to acceptance or rejection of any proposals, and recommendation or award of the contract.

13. AFFIDAVIT OF NON-DISCRIMINATORY EMPLOYMENT

- A. Each Offeror shall execute and submit Form AH, Affidavit of Non-Discriminatory Employment within the sealed envelope containing the Base Proposal.
- B. All Offerors, Contractor and subcontractors shall agree to refrain from discrimination in terms and conditions of employment to the basis of race, color, religion, sex, or national origin, and agrees to take affirmative action as required by Federal Statutes and Rules and Regulations issued in order to maintain and insure non-discriminatory employment practices.

14. CONFLICT OF INTEREST QUESTIONNAIRE

- A. Each Offeror shall execute an on-line Conflict of Interest Questionnaire and submit Form AN within the sealed envelope containing the Base Proposal.

15. PROPOSAL SECURITY

- A. No proposal will be considered unless it is accompanied by a Certified or Cashier's Check or Proposal Bond executed on the form attached. In either case the amount shall be **not less than ten percent (10%) of the greatest amount proposed (considering alternates, if any)**. The proposal security shall insure the execution of the contract and the furnishing of acceptable Performance Bond, Payment Bond and Certificates of Insurance by the successful Offeror within ten (10) days after notification of award to such Offeror and that this proposal will not be withdrawn within sixty (60) days after date of opening of proposals without the consent of the Owner. Proposal Bond shall be submitted on AIA Document A310TM-2010 or on Form AD included in the Project Manual.
- B. Proposal Security shall be submitted within the sealed envelope containing Alternate Proposals.
- C. Withdrawal of a proposal by an Offeror, or refusal to enter into negotiations and/or acceptance of a contract for construction by an Offeror after the opening of proposals and within and including the sixtieth day after proposals shall subject the Offeror to the forfeiture of his proposal security to the Owner.

16. SUBMISSION OF POST PROPOSAL INFORMATION

- A. Each Offeror shall submit, by **5:00P.M. on TBD**, following documentation to the office of the Architect. The post proposal information submitted by the Offeror will be considered by the Selection Committee in the evaluation of the Offeror's proposal:
1. A bar-chart construction schedule delineating construction phasing including major construction milestone dates.
 2. A statement describing the Offeror's proposed management concept for the Project.
 3. A statement of all Work to be self-performed by the Offeror.
 4. Complete and fully executed Contractor Qualification Statement Form, AIA Document A305, for each of the subcontractors named on the Offeror's Alternate Proposal Form. Qualification statements must include a listing of past projects performed by the subcontractor that are of similar size and scope to the Project. Past project information must include the names and telephone numbers of the respective Owner's and Architect's representatives for those projects.
 5. Any voluntary Value Engineering items that the proposer would believe to be of interest to the Owner. (This VE list will not be considered part of the evaluation process and is entirely voluntary.)
 6. As part of post proposal negotiations the Owner may desire to discuss a voluntary option that would establish the amount to be added to the owner's contingency allowance as an incentive amount offered by the general contractor and identified sub-contractors for early payments made by the owner to the general contractor on or before the 15th day of each month following the specified billing period. In addition, General Contractor agrees to maintain timely payments to subcontractors upon payment to the general contractor by the owner. This incentive is made to the owner as a lump sum for each trade contract participating, the proposed amount offered is for the duration of the contract and shall be allocated on a percentage complete of total contract value per month per contractor or subcontractor offering the incentive for early payment. The amount of the incentive each month shall be the proposed value by trade for the incentive multiplied by the percentage completed that month of that trade or generals total contract, if the owner makes payment to the general contractor on or before the 15th day of the month following the billing period then the incentive would be recognized as a credit to the owners contingency allowance, if the payment is not made on or before the 15th by the owner then the incentive credit to the Owner that month would not be applied.

A value for this incentive for the general contractor and the proposed list of subcontractors and values proposed for each that want to participate in this option will be submitted by the highest ranked proposer during post proposal negotiations.
- B. The selected Offeror shall execute Form AL, Certification of Project Compliance, and submit at Project Closeout.
- C. The selected Offeror shall execute and submit Form AP, Certification of Criminal History Record Information within 10 days after receipt of Notice to Proceed and prior to commencement of Work.

17. REJECTION OF PROPOSALS

- A. The Owner shall have the right to reject any or all proposals and to reject a proposal not accompanied by any required proposal security, or by other data required by the Proposal Documents, or to reject a proposal which is in any way incomplete, irregular, or not submitted by the published date and time as specified.

18. EVALUATION OF PROPOSALS

- A. The Owner may discuss proposals with Offerors after the proposal opening, to allow for clarification.

- B. The Owner shall endeavor to prevent non-monetary information from competing proposals being disclosed to other Offerors.
- C. The Owner will, within forty-five (45) days after the proposal opening, evaluate and rank each proposal submitted relative to the selection criteria.
- D. The Owner’s Selection Committee will select the Offeror that offers the best value based on the selection criteria and the Selection Committee’s ranking of the proposals.
- E. The Owner and Architect may discuss options with the selected Offeror for cost reduction and/or other Contract terms. If the Owner is unable to come to terms with the first ranked Offeror, discussions are to terminate and the Owner will proceed to the next ranked Offeror and repeat the process until a contract agreement is reached or all proposals are rejected.

19. DETERMINATION OF SUCCESSFUL RESPONDENT AND AWARD OF CONTRACT

A. In determining the Selected Offeror, the Owner will evaluate the information derived from the Offeror's (Contractor’s) Qualification Statement, information received from completed Offeror’s reference surveys, direct experience with the Offeror by Selection Committee members, the Offeror’s proposal including information requested with the proposals and post proposal information submitted by the Offeror relative to the following Selection Criteria. A maximum of **one hundred twenty (120) points** may be scored to each proposal.

| | |
|---|-----|
| 1. Purchase Price – The purchase price will be scored mathematically as a weighted percentile score utilizing the proposal submitted and the weighted value of the criterion | 40 |
| 2. Reputation – Offeror and the Offeror’s goods and services for projects of similar size and scope | 10 |
| 3. Quality – Offeror and the Offeror’s goods and services for projects of similar size and scope | 10 |
| 4. Completion – Offerors past record of completing projects of similar size and scope on time and within budget | 10 |
| 5. Warranty – Offeror’s response to warranty work requests, the quality of the warranty work, and the Offeror’s record of monitoring and reporting back to the Owner on the progress of warranty work | 10 |
| 6. Close Out – Offeror’s record of closing out projects expeditiously | 10 |
| 7. Project Team – The qualifications of the Offeror’s proposed project manager(s) and project superintendent(s) | 10 |
| 8. Subcontractors – The qualifications of the Offeror’s proposed subcontractors | 20 |
| Total: | 120 |

The Selection Committee consisting of Cypress-Fairbanks ISD administrators, architects, consultants and other staff will make an initial evaluation of the proposals. Its recommendation will be considered by the Cypress-Fairbanks ISD Board of Trustees (“Board”). The District reserves the right to review the recommendation with the Asst. Supt. of Facilities & Construction, the Director of Construction Field Services, the Director of Design and Facilities Planning, and the Director of Project Management and others deemed appropriate by the District prior to review by the entire Board. The final decision-making authority on the proposals rests with the full Board. Decision-making authority has not been delegated to any person or entity other than the Board.

20. AWARD OF CONTRACT

- A. The Owner's Selection Committee's recommendation based on an evaluation and ranking of each proposal submitted in relation to the selection criteria will be presented to the Board of Trustees for approval and award of the contract for construction. Presentation of the Selection Committee's recommendation is anticipated to occur during the Board of Trustees' meeting on **February 10, 2025**.
- B. The Owner or the Architect, on behalf of the Owner, will issue a written Notice to Proceed after award of the contract for construction by the Board of Trustees.
- C. The selected Offeror shall submit to the Owner, for review and acceptance, a Performance Bond, a Payment Bond and Certificates of Insurance within ten (10) calendar days after receipt of a written Notice to Proceed.
- D. All Offerors shall hold pricing of all alternates open for consideration and acceptance by the District/Owner as noted on Alternates proposal form.

21. ON SITE MOBILIZATION

- A. The selected Offeror shall not commence on-site work under this Contract until he receives a written confirmation from the Owner approving the Performance Bond, Payment Bond and Certificates of Insurance. Timely submittal of correct Bonds and Certificate of Insurance is solely the responsibility of Offeror. Additional review time by the Owner due to Contractor's failure to do so will not constitute grounds for delay claims.

22. CONTRACT TIME AND LIQUIDATED DAMAGES

- A. Refer to the AIA Document A201TM-2017, as Amended for Contract Time and Liquidated Damages provisions of the Contract.

23. AVAILABILITY OF MATERIALS AND SYSTEMS

- A. A serious effort has been made to select only materials that are asbestos free and systems that are readily available. As far as is known at proposal time all items are either available "off the shelf" or within a relatively short period of time. If during the proposal period, an Offeror becomes aware of an availability or delivery problem with any of the specified systems or materials or if they contain asbestos, he should notify the Architect immediately. The Architect will promptly explore possibilities for selecting other systems or materials which would circumvent the problem and notify Offerors of any changes in an addendum, otherwise it will be understood that only specified systems and materials that are asbestos free are included in the proposals.
- B. Decisions regarding allowance items will endeavor to be made in a timely manner to avoid construction delays.

EXHIBIT A
REFERENCE LISTING FOR Cy-Fair ISD
2024 Cy Ridge HS Renovation

OFFEROR NAME: _____

| | |
|---------------------------|------------------------|
| PROJECT No. 1 | |
| Project Name: _____ | Completion Date: _____ |
| Contract Amount: \$ _____ | Square Footage: _____ |
| OWNER | ARCHITECT |
| Contact Name: _____ | Contact Name: _____ |
| Phone Number: _____ | Phone Number: _____ |
| or Email: _____ | or Email: _____ |

| | |
|---------------------------|------------------------|
| PROJECT No. 2 | |
| Project Name: _____ | Completion Date: _____ |
| Contract Amount: \$ _____ | Square Footage: _____ |
| OWNER | ARCHITECT |
| Contact Name: _____ | Contact Name: _____ |
| Phone Number: _____ | Phone Number: _____ |
| or Email: _____ | or Email: _____ |

| | |
|---------------------------|------------------------|
| PROJECT No. 3 | |
| Project Name: _____ | Completion Date: _____ |
| Contract Amount: \$ _____ | Square Footage: _____ |
| OWNER | ARCHITECT |
| Contact Name: _____ | Contact Name: _____ |
| Phone Number: _____ | Phone Number: _____ |
| or Email: _____ | Or Email: _____ |

END OF SECTION

FORM AC
COMPETITIVE SEALED PROPOSAL FORM - BASE PROPOSAL

2024 CY RIDGE HS RENOVATION
Cypress-Fairbanks Independent School District
Cypress-Fairbanks I.S.D. Proposal Number: 24-02-5752R-RFP
Attn: Mr. Jesse Clayburn, Asst. Superintendent of Facilities & Construction

Submitted by: _____

Date: _____ Phone No.: _____

To: Board of Trustees
Cypress-Fairbanks Independent School District
Facilities and Construction
11430-B Perry Road
Houston, Texas 77064

Having examined Proposal and Contract Documents prepared by **Page Architects** dated **December 9, 2024**, and having examined site conditions, the undersigned proposes to furnish all labor, equipment and materials and perform all work for the completion of the above-named project for the sum indicated below.

In submitting his Proposal, the undersigned agrees to the following:

1. Hold Base Proposal open for acceptance sixty (60) days.
2. Accept right of Owner to reject any or all proposals, to waive formalities and to accept proposal which Owner considers most advantageous.
3. Enter into and execute the contract, if awarded, for the Base Proposal and accepted Alternate Proposals.
4. Complete work in accordance with the Contract Documents within the stipulated contract time.
5. By signing, the undersigned affirms that, to the best of his knowledge, the Proposals have been arrived at independently and is submitted without collusion with anyone to obtain information or gain any favoritism that would in any way limit competition or give an unfair advantage over respondents in the award of this proposal.

I. BASE PROPOSAL

A. Undersigned agrees to complete the Work for the lump sum amount of:

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

II. ALLOWANCES

Undersigned certifies that the allowances specified in Section 01 21 00 are included in the Base Proposal and agrees that unexpended balance of allowance sums will revert to Owner in the final settlement of the contract.

III. CONTRACT TIME

By submittal of this proposal, the undersigned stipulates that the Base Proposal includes all costs necessary to attain Substantial Completion of the Work on or before the date stipulated in AIA Document A101™-2017.

THIS PAGE OF PROPOSAL FORM MUST BE SUBMITTED BY 2:00 PM, January 7, 2025
COMPETITIVE SEALED PROPOSAL FORM - BASE PROPOSAL

IV. ADDENDA

Undersigned acknowledges receipt of Addenda Nos. _____ dated _____.

V. CHANGES IN THE WORK

Undersigned understands that changes in the work shall be performed in accordance with the Supplementary Conditions.

VI. LIQUIDATED DAMAGES

By submittal of this proposal, the undersigned stipulates an agreement that if Substantial Completion of the Work is not attained on or before the date stipulated in AIA Document A101™-2017, the undersigned and his Surety shall be liable for and shall pay the Owner the sums stipulated as Liquidated Damages as defined in AIA Document A201™-2017.

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.

Authorized Signature

Printed Name

Title

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

Name of Contracting Firm

Address

Telephone

Date

THIS PAGE OF PROPOSAL FORM MUST BE SUBMITTED BY 2:00 PM, January 7, 2025
COMPETITIVE SEALED PROPOSAL FORM - BASE PROPOSAL

FORM AC
COMPETITIVE SEALED PROPOSAL FORM - ALTERNATE PROPOSALS

2024 CY RIDGE HS RENOVATION
Cypress-Fairbanks Independent School District
Cypress-Fairbanks I.S.D. Proposal Number: 24-02-5752R-RFP
Attn: Mr. Jesse Clayburn, Asst. Superintendent of Facilities & Construction

Submitted by: _____

Date: _____ Phone No.: _____

To: Board of Trustees
Cypress-Fairbanks Independent School District
Facilities and Construction
11430-B Perry Road
Houston, Texas 77064

Having examined Proposal and Contract Documents prepared by **Page Architects**, dated **December 9, 2024**, and having examined site conditions, the undersigned proposes to furnish all labor, equipment and materials and perform all work for the completion of the above-named project for the sum indicated below.

In submitting his Proposal, the undersigned agrees to the following:

1. Hold Alternate Proposal open for acceptance one hundred twenty (120) days.
2. Accept right of Owner to reject any or all proposals, to waive formalities and to accept proposal which Owner considers most advantageous.
3. Enter into and execute the contract, if awarded, for the Base Proposal and accepted Alternate Proposals.
4. Complete work in accordance with the Contract Documents within the stipulated contract time.
5. By signing, the undersigned affirms that, to the best of his knowledge, the Proposals have been arrived at independently and is submitted without collusion with anyone to obtain information or gain any favoritism that would in any way limit competition or give an unfair advantage over respondents in the award of this proposal.

I. ALTERNATES

If the Owner accepts any or all of the Alternates, the undersigned agrees to modify the Base Proposal as stipulated below:

A. Alternate Number 1 – **Base Bid Adjustment**

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

B. Alternate Number 2A – **Chillers by Carrier**

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

C. Alternate Number 2B – **Chillers by Daikin**

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

THIS PAGE OF PROPOSAL FORM MUST BE SUBMITTED BY 3:00 PM, January 7, 2025
COMPETITIVE SEALED PROPOSAL FORM - ALTERNATE PROPOSAL

D. Alternate Number 2C – *Chillers by Daikin*

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

E. Alternate Number 2D – *Chillers by Trane*

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

F. Alternate Number 3A – *Two Cell Counterflow Cooling Tower by Evapco*

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

G. Alternate Number 3B – *Three Cell Counterflow Cooling Tower by Evapco*

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

H. Alternate Number 3C – *Two Cell Counterflow Cooling Tower by Marley*

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

II. UNIT PRICES

If the Owner accepts any or all of the Alternates, the undersigned agrees to add or subtract the following units of work:

UNIT PRICE 1: ELECTRICAL DUPLEX RECEPTACLE

Provide unit price for a new 20A, 120V duplex electrical receptacle and cover plate, flush mounted in a CMU, metal stud, or demountable wall construction, circuited to an existing electrical panel within 150 feet of the outlet using a branch circuit consisting of 2 #10 AWG and 1 #10 AWG ground in 3/4-inch EMT conduit. All conduits to be concealed in wall construction. Unit price shall include a 20-amp circuit breaker to be installed in existing panel space.

UNIT PRICE 2: DATA DROP

Provide unit price for a data drop, flush mounted in a CMU, metal stud or demountable wall construction, wired to an IDF/MDF Room. The data drop shall consist of a single gang wall box, cabling wiring device, cover plate, 3/4-inch conduit from outlet to above accessible ceiling, plenum-rated cabling routed above accessible ceiling to the nearest MDF or IDF location within 250 feet of the outlet. Termination and testing to be included in the unit price.

UNIT PRICE 3: 4 1/2" THICK CONCRETE WALK PER SQUARE FOOT

This unit cost shall establish the amount to the contract price for the Contractor to add or deduct 4 1/2" thick concrete walk (minimum 100 SF) per Square Foot.

UNIT PRICE 4: 7" THICK CONCRETE DRIVE PER SQUARE FOOT

This unit cost shall establish the amount to the contract price for the Contractor to add or deduct 7" thick concrete drive (minimum 100 SF) per Square Foot.

UNIT PRICE 5: CONCRETE SLAB PER SQUARE FOOT

This unit cost shall establish the amount to the contract price for the Contractor to add or deduct 7" thick concrete drive (minimum 100 SF) per Square Foot.

UNIT PRICE 6: DEMO CONCRETE SLAB PER SQUARE FOOT

This unit cost shall establish the amount to the contract price for the Contractor to add or deduct 7" thick concrete drive (minimum 100 SF) per Square Foot.

THIS PAGE OF PROPOSAL FORM MUST BE SUBMITTED BY 3:00 PM, January 7, 2025
COMPETITIVE SEALED PROPOSAL FORM - ALTERNATE PROPOSAL

UNIT PRICE 7: LIFE SAFETY DEVICES (including all associated cabling and programming)

This unit cost shall establish the amount to be added or deducted from the contract price for the Contractor to add /deduct Fire Alarm devices.

| | | | |
|------|-----------------------------------|----------|------|
| III. | 1. Exterior Horn to Speaker | \$ _____ | each |
| | 2. Interior Horn to Speaker | \$ _____ | each |
| | 3. Interior Visual Strobe | \$ _____ | each |
| | 4. Interior Speaker/Visual Strobe | \$ _____ | each |
| | 5. Smoke Detector | \$ _____ | each |
| | 6. Heat Detector | \$ _____ | each |
| | 7. Manual Pull Station | \$ _____ | each |
| | 8. Stopper 2 Pull Station Cover | \$ _____ | each |
| | 9. Annunciator Panel | \$ _____ | each |
| | 10. Duct Detector | \$ _____ | each |
| | 11. Relay | \$ _____ | each |
| | 12. Supervisory | \$ _____ | each |
| | 13. Waterflow | \$ _____ | each |
| | 14. Amplifier | \$ _____ | each |
| | 15. Remote Power Supply | \$ _____ | each |

UNIT PRICE 8: GRAPHIC SIGNS

This unit cost shall establish the amount to be added or deducted to the contract price for the Contractor to remove existing signage and install new as described below:

| | | |
|---------------------------------------|------------|------|
| 1. Sign Type A | \$ _____ / | each |
| 2. Sign Type B | \$ _____ / | each |
| 3. Sign Type C | \$ _____ / | each |
| 4. Sign Type D | \$ _____ / | each |
| 5. Sign Type E | \$ _____ / | each |
| 6. Sign Type F | \$ _____ / | each |
| 7. Max Occupancy Signage | \$ _____ / | each |
| 8. FDC Connection Signage | \$ _____ / | each |
| 9. Wayfinding Signage (2 lines text) | \$ _____ / | each |
| 10. Wayfinding Signage (3 lines text) | \$ _____ / | each |
| 11. Wayfinding Signage (4 lines text) | \$ _____ / | each |

UNIT PRICE 9: PAINTING

This unit cost shall establish the amount to be added or deducted to the contract price for the Contractor to paint 100 square feet of wall (minimum 400 square feet of wall).

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 COMPETITIVE SEALED PROPOSAL FORM - ALTERNATE PROPOSAL

UNIT PRICE 10: ASBESTOS ABATEMENT COMPONENTS

This unit cost shall establish the amount to be added or deducted to the contract price for the Contractor to add/deduct asbestos abatement components as described below:

| No. | Unit Price Description | Add(\$/Figures) | Unit of Measure |
|-----|---|-----------------|-------------------|
| | ASB-1 Price per unit for the proper removal, transportation, and disposal of interior ACBM Mirror Mastic. All work to be Completed in compliance with AHERA and TAHPR regulations. (Full Containment) | _____ | Individual Mirror |

UNIT PRICE 11: EXIT SIGN

This unit cost shall establish the amount to be added to the contract price to provide and install one (1) exit sign. Price shall include wiring to nearest available emergency circuit, up to 200 feet.

UNIT PRICE 12: ORNAMENTAL FENCE

This unit cost shall establish the amount to be added or deducted from the contract price for the Contractor to add/deduct ornamental fence.

- 1. 6-foot-high fence \$ _____ / linear foot
- 2. 6-foot-high x 4-foot-wide gate \$ _____ / per leaf
- 3. 6-foot-high x 6-foot-wide gate \$ _____ / per leaf

UNIT PRICE 13: SECURITY FILM

This unit cost shall establish the amount to be added to the contract price to provide and install security film on existing exterior glazing (minimum 200 square feet).

- 1. ~~Armoured~~ One \$ _____ / Square foot

CONTRACTOR'S PROJECT TEAM MEMBERS

The undersigned proposes the following project team members (include resumes):

Project Manager _____

Superintendent _____

Asst. Superintendent(s) _____

THIS PAGE OF PROPOSAL FORM MUST BE SUBMITTED BY 3:00 PM, January 7, 2025
COMPETITIVE SEALED PROPOSAL FORM - ALTERNATE PROPOSAL

Project Engineer _____

THIS PAGE OF PROPOSAL FORM MUST BE SUBMITTED BY 3:00 PM, January 7, 2025
COMPETITIVE SEALED PROPOSAL FORM - ALTERNATE PROPOSAL

III. PROPOSED SUBCONTRACTORS

The undersigned proposes the following subcontractors. Note – Not all trades listed below will apply to every project.

Paving: _____

Abatement: _____

Dampproofing/insulator: _____

Masonry: _____

Roofing: _____

Drywall: _____

Casework: _____

Concrete: _____

Plumbing: _____

Mechanical: _____

Electrical: _____

Fire Alarm: _____

Sprinkler: _____

Low Voltage/Security: _____

Site Utilities: _____

Earthwork/Site Prep: _____

Fencing: _____

Pre-Engineered Metal Building: _____

Glazing: _____

THIS PAGE OF PROPOSAL FORM MUST BE SUBMITTED BY 3:00 PM, January 7, 2025
COMPETITIVE SEALED PROPOSAL FORM - ALTERNATE PROPOSAL

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

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

Authorized Signature

Printed Name

Title

Name of Contracting Firm

Address

Telephone

Date

END OF FORM

THIS PAGE OF PROPOSAL FORM MUST BE SUBMITTED BY 3:00 PM, January 7, 2025
COMPETITIVE SEALED PROPOSAL FORM - ALTERNATE PROPOSAL

FORM AD

PROPOSAL BOND

KNOW ALL MEN BY THESE PRESENTS, that we _____,
as Principal, and _____, as Surety, are held and firmly
bound unto the Cypress-Fairbanks Independent School District, Harris County, Texas, hereinafter called the Owner, in
the penal sum of _____ Dollars
(\$ _____) lawful money of the United States, for the payment of which sum well and truly to be made, we
bind ourselves, our heirs, executors, administrators and successors jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH, that whereas the Principal has submitted the accompanying
Proposal, dated _____, _____, being for the _____, Cypress-Fairbanks
I.S.D. Proposal Number: **24-02-5752R-RFP** for the Cypress-Fairbanks Independent School District, the kind and extent
of work involved being set forth in detail in the proposed Contract Documents cited herein.

NOW, THEREFORE, if the Principal shall not withdraw the accompanying proposal within 60 days after the date set
for opening thereof, and shall within ten (10) days after the prescribed forms are presented to him for signature, enter into
a written contract with the Owner in accordance with the Proposal as accepted; and give Bond and good and sufficient
surety for the faithful performance and proper fulfillment of such contract including payment of all persons supplying
labor or materials therefor, or in the event of the withdrawal of said proposal within the period specified, or the failure to
enter into such contract and give such bond within the time specified, if the Principal shall pay to the Owner the difference
between the aggregate amount for which the Owner may enter into a contract for the same work with another Respondent;
if the latter amount be in excess of the former, then the above obligation shall be void and of no effect, otherwise to
remain in full force and virtue.

IN WITNESS WHEREOF, the above bonded parties have executed this instrument under their several seals this _____
day of _____, _____, the name and Corporate Seal of each corporate party being
hereto affixed and these presents duly signed by its undersigned representatives, pursuant to authority of its governing
body.

Business Address

Individual Principal: Signature and Printed Name

Business Address

Individual Principal: Signature and Printed Name

ATTEST:

Secretary President

BY: _____

Business Address

Corporate Surety

ATTEST: _____

BY: _____

END OF FORM

NOTE: THIS FORM MUST BE EXECUTED AND SUBMITTED WITH ALTERNATE PROPOSAL.

FORM AE

FELONY CONVICTION NOTIFICATION

Note: The Statement of Affirmation Must Be Notarized

STATEMENT OF AFFIRMATION

“The undersigned affirms that he/she is duly authorized to provide this information by the person(s) or business entity making the proposal, and the information provided below concerning felony convictions has been personally and thoroughly reviewed, and verified, and is, therefore, current, true and accurate to the best of my knowledge.”

Firm’s Name: _____ Address: _____

- “a. ___ My firm is a publicly held corporation, therefore, this reporting requirement is not applicable.”
- “b. ___ My firm is not owned nor operated by anyone who has been convicted of a felony.”
- “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) _____

PLEASE CHECK a, b, or c ABOVE AND SIGN BELOW

Offeror’s Printed Name _____ Position/Title _____

Offeror’s Signature _____ Date _____

Subscribed and sworn to me on this _____ day of _____, 20__.

Notary Public

My Commission expires _____

NOTE: THIS FORM MUST BE EXECUTED AND SUBMITTED WITH BASE PROPOSAL

END OF FORM

FORM AG

PROPOSAL EVALUATION WAIVER

By submitting a Proposal, the proposer indicated below agrees to waive any claim it has or may have against the Owner, Architect, Engineers, Consultants and their respective employees, arising out of or in connection with the administration, evaluation, or recommendation of any proposal. The proposer further agrees the Owner reserves the right to waive any requirements under the proposal documents or the Contract Documents, with regards to acceptance or rejection of any proposals, and recommendation or award of the contract.

NOTE: The Statement of Affirmation Must Be Notarized.

STATEMENT OF AFFIRMATION

“The undersigned affirms that he/she is duly authorized to execute this waiver by the person(s) or business entity making the proposal.”

Firm’s Name _____ Address: _____

Proposer’s Printed Name _____ Position/Title _____

Proposer’s Signature _____ Date _____

Subscribed and sworn to me on this _____ day of _____, _____.

Notary Public

My Commission expires _____

NOTE: THIS FORM MUST BE EXECUTED AND SUBMITTED WITH BASE PROPOSAL.

END OF FORM

FORM AH

AFFIDAVIT OF NON-DISCRIMINATORY EMPLOYMENT

STATE OF TEXAS)
)
COUNTY OF HARRIS)

AFFIDAVIT

This Company, Contractor, or Subcontractor agrees to refrain from discrimination in terms and conditions of employment to the basis of race, color, religion, sex, or national origin, and agrees to take affirmative action as required by Federal Statutes and rules and Regulations issued pursuant thereto in order to maintain and insure non-discriminatory employment practices.

SIGNED: _____ DATE: _____

PRINTED NAME: _____

TITLE: _____

COMPANY: _____

The person signing above hereby certifies that he or she is fully authorized and empowered to execute this instrument and to bind the person or entity named hereto and does in fact so execute this instrument.

STATE OF TEXAS

COUNTY OF _____)

Subscribed and sworn before me on this _____ day of _____, _____.

Notary Public

My Commission expires _____

NOTE: THIS FORM MUST BE EXECUTED AND SUBMITTED WITH BASE PROPOSAL

END OF FORM

FORM AI

FORM 1: CONDITIONAL WAIVER FOR PROGRESS PAYMENT

CONDITIONAL WAIVER AND RELEASE ON PROGRESS PAYMENT

Cypress-Fairbanks Independent School District

2024 CY RIDGE HS RENOVATION

Cypress-Fairbanks ISD Proposal Number: 24-02-5752R-RFP

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 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 lay 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 **Cypress-Fairbanks Independent School District** (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 paying 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__.

Notary Public in and for the state of _____.

FORM AI

FORM 2: UNCONDITIONAL WAIVER FOR PROGRESS PAYMENT

UNCONDITIONAL WAIVER AND RELEASE ON PROGRESS PAYMENT

Cypress-Fairbanks Independent School District

2024 CY RIDGE HS RENOVATION

Cypress-Fairbanks ISD Proposal Number: 24-02-5752R-RFP

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 Cypress-Fairbanks Independent School District (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 statements(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__.

_____ Notary Public in and for the state of _____.

FORM AI

FORM 3: CONDITIONAL WAIVER FOR FINAL PAYMENT

CONDITIONAL WAIVER AND RELEASE ON FINAL PAYMENT

Cypress-Fairbanks Independent School District

2024 CY RIDGE HS RENOVATION

Cypress-Fairbanks ISD Proposal Number: 24-02-5752R-RFP

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 **Cypress-Fairbanks Independent School District** (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), inclusive of all modifications and changes therein.

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__.

Notary Public in and for the state of _____.

FORM AI

FORM 4: UNCONDITIONAL WAIVER FOR FINAL PAYMENT

UNCONDITIONAL WAIVER AND RELEASE ON FINAL PAYMENT

Cypress-Fairbanks Independent School District

2024 CY RIDGE HS RENOVATION

Cypress-Fairbanks ISD Proposal Number: 24-02-5752R-RFP

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

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 **Cypress-Fairbanks Independent School District** (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 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__.

_____ Notary Public in and for the state of _____.

FORM AJ

WARRANTY CERTIFICATE

PROJECT NAME: 2024 Cy Ridge HS Renovation
Cypress-Fairbanks I.S.D. Proposal Number: 24-02-5752R-RFP
Architect's Project Number: 33AC23221
Address: _____

OWNER NAME: *Cypress-Fairbanks Independent School District* **Phone No.** *(281) 897-4108*

_____ Warrants _____
(Name of Company) (Description of Work/Products/ Division Number)

_____ against defective materials, workmanship, machinery, hardware, and equipment. The above-mentioned company agrees to repair or replace such defective items at its own expense for a period of _____ year/s from the Date of Substantial Completion.

FIRM ISSUING WARRANTY: _____ **Phone No.** _____

Address: _____ **City** _____ **State** _____ **Zip** _____

IN WITNESS WHEREOF, the above bonded parties have executed this instrument under their several seals this _____ day of _____, _____, the name and Corporate Seal of each corporate party being hereto affixed and these presents duly signed by its undersigned representatives, pursuant to authority of its governing body.

(Printed Name) (Signature) (Title)

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

Subscribed and sworn before me on this _____ day of _____, _____.

Notary Public

My Commission expires _____

FORM AK

AFFIDAVIT OF NON-ASBESTOS, LEAD, AND PCB USE IN PROJECT

Complete this form and return to the Architect upon close-out of the project.

PROJECT NAME: 2024 Cy Ridge HS Renovation

Cypress-Fairbanks I.S.D. Proposal Number: 24-02-5752R-RFP

Architect's Project Numbers: 33AC23221

OWNER NAME: Cypress-Fairbanks Independent School District

Phone No. (281) 897-4108

Address: 11440 Matzke Rd., Cypress, Texas 77429

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 bibs, as applicable to the project. Lead sheet flashing used in through roof plumbing penetration applications is the only permissible lead-containing material on the Project.

SIGNED: _____

DATE: _____

PRINTED NAME: _____

TITLE: _____

COMPANY: _____

The person signing above hereby certifies that he or she is fully authorized and empowered to execute this instrument and to bind the person or entity named hereto and does in fact so execute this instrument.

STATE OF TEXAS

COUNTY OF _____)

Subscribed and sworn before me on this _____ day of _____, _____.

Notary Public

My Commission expires _____

END OF FORM

CERTIFICATION OF PROJECT COMPLIANCE

Completion of this form is required under the provisions of §61.1036(c)(3)(F) TAC for all public school district construction projects. Instructions for completion of this form can be found on page 2.

1. PROJECT INFORMATION

DISTRICT: Cypress-Fairbanks I.S.D.

Facility: 2024 Cy Ridge HS Renovation

ARCHITECT/ENGINEER: Page Southerland Page, Inc.

Address: 7900 N. Eldridge Pkwy

CONTRACTOR/CM: TBD

City: Houston, TX 77041

CONTRACT DATE: TBD

DATE DISTRICT AUTHORIZED PROJECT: 2019 Bond authorized 5/4/19, Phase 6 authorized 11/1/23

BRIEF DESCRIPTION OF PROJECT:

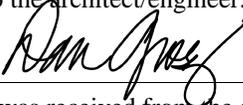
CFISD Project Number: 24-02-5752-R-RFP

Various renovations, program additions, mechanical/electrical/plumbing upgrades and security enhancements to an existing high school.

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 that the educational program and the educational specifications of this facility along with the identified building code to be used have been provided to the architect/engineer.

DISTRICT: Cypress-Fairbanks I.S.D. **BY:**  **DATE:** 2/29/2024

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 facility has been designed to meet or exceed the design criteria relating to space (minimum square footage), educational adequacy, and construction quality as contained in the School Facilities Standards as adopted by the Commissioner of Education, June 9, 2003, and as provided by the district.

ARCHITECT/ENGINEER: Arcadis **BY:** **DATE:**

5. The Contractor/CM certifies that this project has been constructed in general conformance with the construction documents as prepared by the architect/engineer listed above.

CONTRACTOR/CM: TBD **BY:** **DATE:**

6. The District certifies completion of the project (as defined by the architect/engineer and contractor).

DISTRICT: Cypress-Fairbanks I.S.D. **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 §61.1033 or §61.1036, 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.

SECTION AN

Conflict of Interest Questionnaire

According to Local Government Code, Chapter 176, a person or an agent of a person who contracts or seeks to contract for the sale or purchase of property, goods, or services with Cypress-Fairbanks Independent School District must file a completed Conflict of Interest Questionnaire with the Purchasing Department not later than the seventh business day after the date that the person begins contract discussions or negotiations with the District or submits to the District an application, response to a request for proposals or bids, correspondence, or another writing related to a potential agreement with the District.

Each Proposer must complete the on-line version of the Conflict Of Interest Questionnaire at the following website:

<https://app.cfsd.net/ciq/index.aspx>

Full instructions for completing the Questionnaire are included at this website.

CERTIFICATION OF PROPOSER'S COMPLETION OF CONFLICT OF INTEREST QUESTIONNAIRE

The undersigned certifies that he has completed the Conflict of Interest Questionnaire per the above information.

Authorized Signature

Printed Name

Title

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

Name of Contracting Firm

Address

Telephone

Date

TO BE INITIALED BY ARCHITECT AND CONTRACTOR PRIOR TO OWNER'S FINAL CLOSEOUT REVIEW

PROJECT NAME:

NOTE: SUBMIT ALL DOCUMENTS RELATED TO SUBCONTRACTORS AND SUPPLIERS IN ALPHABETICAL ORDER BY NAME OF COMPANY UNLESS NOTED OTHERWISE

| | <u>Contractor's</u> <u>Initials</u> | <u>Architect's</u> <u>Initials</u> | <u>CFISD PM</u> <u>Initials</u> |
|--|--|---------------------------------------|------------------------------------|
| CFISD Close Out Log - with Subcontractors Filled Out | _____ | _____ | _____ |
| List of Project Team | _____ | _____ | _____ |
| List of Final Subcontractor/Suppliers/Local Representatives (Form AF) | _____ | _____ | _____ |
| "Consent of Surety to Final Payment" AIA G707 <input type="checkbox"/> 1. Check for Corporate Seal <input type="checkbox"/> 2. Check for Original Signature <input type="checkbox"/> 3. Check for Project Name | _____ | _____ | _____ |
| "Contractor's Affidavit of Payment of Debts and Claims" AIA G706 <input type="checkbox"/> 1. Check for Notary <input type="checkbox"/> 2. Check for Original Signature <input type="checkbox"/> 3. Check for Project Name | _____ | _____ | _____ |
| "Contractor's Affidavit of Release of Liens" AIA G706A <input type="checkbox"/> 1. Check for Notary <input type="checkbox"/> 2. Check for Original Signature <input type="checkbox"/> 3. Check for Project Name | _____ | _____ | _____ |
| Subcontractors' Waiver of Lien (Subcontractors/Major Suppliers) (Conditional or Unconditional) (Form AI) <input type="checkbox"/> 1. Check against Subcontractor List <input type="checkbox"/> 2. Check for Notary <input type="checkbox"/> 3. Check for Original Signature <input type="checkbox"/> 4. Check for Project Name | _____ | _____ | _____ |
| "Certificate of Substantial Completion" AIA G704 | _____ | _____ | _____ |
| Allowances <input type="checkbox"/> 1. <i>CPR Execution Complete (Owner)</i> <input type="checkbox"/> 2. <i>Account Balance Review (Owner)</i> <input type="checkbox"/> 3. Executed Final Change Order | _____ | _____ | _____ |
| Architect letter confirming all punch list items complete (Architect) <input type="checkbox"/> 1. Final Signed Off Punch list | _____ | _____ | _____ |
| List of All Permits during Job and a Copy of All Permits | _____ | _____ | _____ |
| Storm Water Quality Permit (As-Built Certificate) <input type="checkbox"/> 1. Check for Original Signature <input type="checkbox"/> 2. Check for Project Name <input type="checkbox"/> 3. Check for Permit Number <input type="checkbox"/> 4. Check for Engineer License Seal | _____ | _____ | _____ |

Utilities (**Owner**)

- Invoice/Check for Electricity
- Invoice/Check for Gas
- Invoice/Check for Water/Sewer/Irrigation

Contractor's Overtime

- Invoices Sent to Contractor (Owner)
- Payment Received by Contractor (Owner)

Copy of Certificate of Compliance/Occupancy from local governmental Authorities

Project Compliance Certificate (**Owner Form AL**)

- 1. Check for Original Signature
- 2. Check for Project Name

Hazardous Material Certificate (Architect, General Contractor/Contractor, Subcontractors, and Material/Equipment Suppliers) Each shall be notarized. (**Form AK**)

- 1. Check against Subcontractor List
- 2. Check for Notary
- 3. Check for Project Name
- 4. Check for Original Signature

Asbestos Manifest

- Signed by all appropriate parties

Report from Asbestos Consultant confirming abatement observations and air monitoring

- 1. Asbestos Reports
- 2. *Transmit Originals to Maintenance, Keep Copies for File. (Owner)*

Letter from Building Envelope Consultant confirming all deficiency items complete

Roofing Warranty & Documentation

- Send Copies to Director of Maintenance (Owner)*
- Compliance letter on Roofing from Roofing Consultant
- Roofing Manufacturer Letter confirming Warranty
- Copy to Roof Warranty Binder (Owner)
- Place Original in Roof Warranties Binder (Owner)

TDLR Inspection

- Inspection Report
- Deficiencies documented and corrected (if applicable)
- Approval letter from TDLR

Letter from Test & Balance Consultant confirming all deficiency items complete

Letter from Commissioning Consultant confirming all deficiency items complete

Letter from Structural Engineer confirming conformance with design (**provided by Architect**)

Letter from Civil Engineer confirming conformance with design (**provided by Architect**)

Letter from Mechanical Engineer confirming conformance with design (**provided by Architect**)

Letter from Materials Testing Consultant confirming all deficiency items complete

Letter from Consultants confirming conformance with design if applicable (**Provided by Consultant, FDP, C-H, etc.**)

Copy of all Gas Pipe Test Results Form

Elevators

- Maintenance Service Agreement
- Send Copy to Maintenance (Owner)

General Contractor's Written Guarantee (**Form AJ**)

- 1. Check for Notary
- 2. Check for Original Signature
- 3. Check for Project Name

Subcontractors' Written Guarantee (**Form AJ**)

- 1. Check against Subcontractor List
- 2. Check for Original Signature
- 3. Check for Project Name
- 4. Check for Notary
- 5. State date to be date of Substantial Completion of final phase of project

Extended Warranties & Maintenance List

Insurance Certificate documenting continuing coverage after Final Payment (**see AIA Document A201™-2017, as amended, Article 11.1.3**)

Workers' Compensation Certificates

- General Contractor
- ALL Subcontractors

All Extra Stock Transmittals by Division

- Divisions 0 – 21
- Division 22 Plumbing
- Division 23 HVAC
- Division 26 Electrical
- Division 27, 28 and beyond as applicable

CFISD Master Keys Returned

Paint Mix Cards

List of Finishes used in Project

Demonstration and Training Sign In Sheets by Division with Digital Video if applicable

Maintenance/Operations Manuals (2 hard copies, 1 digital copy)
(Reviewed/Approved by Architect)

- Divisions 0 – 21
- Division 22 Plumbing
- Division 23 HVAC
- Division 26 Electrical
- Division 27, 28 and beyond as applicable

Record Drawings / As-Builts

- 1. Record CAD Files
- 2. Record PDF Files

The undersigned Contractor certifies that to the best of the Contractor's knowledge, information and belief the close out documentation attached has been accurately completed in accordance with the Contract Documents, and requests permission to submit the FINAL Application and Certification for Payment AIA G702 Document for the outstanding retainage owed under the contract.

Contractor:

By: _____

Print Name: _____

In accordance with the Contract Documents, based on data comprising the attached, the Architect certifies to the Owner that to the best of the Architect's knowledge, information and belief the Project Close Out Documents have been completed as indicated, the accuracy of the documents is in accordance with the Contract Documents.

Architect:

By: _____

Print Name: _____

CFISD Project Manager Signature: _____

Date: _____

CFISD Director of Project Management Signature: _____

Date: _____

CFISD Director of Contract Management Signature: _____

Date: _____

CFISD Assistant Superintendent Signature: _____

Date: _____

FORM AP – Contractor SB 9 Public Works Contractor Certification

Introduction: Texas Education Code Chapter 22 requires entities that contract with school district contractors to obtain criminal history record information regarding covered employees. Covered employees with disqualifying criminal histories are prohibited from serving at a school district. Contractors must certify to the District that they have complied.

The District may not obtain criminal histories for contractors: The law requires each contractor to obtain the criminal histories of its covered employees.

Definitions:

Covered employees: 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 the opportunity for direct contact with students in connection with the person's continuing duties. 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) a conviction for one of the following offenses during the preceding 30 years, 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 Penal Code; (b) an offense for which a 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. Title 5 felony offenses include criminal homicide; kidnapping, unlawful restraint, and smuggling of persons; trafficking of persons; sexual offenses; and assaultive offenses.

On behalf of _____ ("Contractor"), I, the undersigned authorized signatory for Contractor, certify to Cypress-Fairbanks Independent School District ("District") and Contractor that [check one]:

None of Contractor's employees are *covered employees*, as defined above. If this box is checked, 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 checked, I further certify that:

- 1) Contractor has obtained all required criminal history record information 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 with 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.

All company employees must have a CFISD badge prior to working on district property.

There is a processing fee of \$7 per badge requested, for which an invoice will be submitted. This fee is a processing fee per individual submitted on the Employee List Form and is charged regardless of whether the individual is approved to receive a badge.

If the District objects to the assignment of a covered employee based on 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.

Signature

Date

Title

Submit completed form to: Cypress-Fairbanks ISD, Facilities & Construction Office: contractor_badges@cfisd.net

Notes

Public works contractor employees must have opportunity for *direct contact with students* in order to be subject to a mandatory criminal history review. Tex. Educ. Code § .08341(b)(2). Direct contact with students is contact that results from activities that provide substantial opportunity for verbal or physical interaction with students and that is not supervised by a certified educator or other professional district employee.

For public works contractor employees, a person does not have the opportunity for direct contact with students if:

- the public work does not involve the construction, alteration, or repair of an instructional facility;
- if the public work involves construction of a *new* instructional facility, the person's duties related to the contracted services will be completed not later than the seventh day before the first date the facility will be used for instructional purposes; *or*
- if the public work involves an existing instructional facility:
 - the public work area contains sanitary facilities and is separated from all areas used by students by a secure barrier fence that is not less than six feet in height; *and*
 - the contractor adopts a policy prohibiting employees, including subcontractor employees, from interacting with students or entering areas used by students, informs employees of the policy, and enforces the policy at the public work area.

"Instructional facility" means real property, an improvement to real property, or a necessary fixture of an improvement to real property that is used predominantly for teaching the curriculum required under Texas Education Code section 28.002.

FORM AP - Subcontractor SB 9 Public Works Contractor Certification

Introduction: Texas Education Code Chapter 22 requires entities that contract with school district contractors to obtain criminal history record information regarding covered employees. Covered employees with disqualifying criminal histories are prohibited from serving at a school district. Subcontractors must certify to the District and to the contractor that they have complied.

The District may not obtain criminal histories for subcontractors: The law requires each subcontractor to obtain the criminal histories of its covered employees.

Definitions:

Covered employees: Employees of a subcontractor who have or will have continuing duties related to the service to be performed at the District and have or will have the opportunity for direct contact with students in connection with the person's continuing duties. 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) a conviction for one of the following offenses during the preceding 30 years, 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 Penal Code; (b) an offense for which a 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. Title 5 felony offenses include criminal homicide; kidnapping, unlawful restraint, and smuggling of persons; trafficking of persons; sexual offenses; and assaultive offenses.

Subcontractor has entered a contract with _____ ("Contractor") to provide services in connection with contract between Cypress-Fairbanks Independent School District ("District") and Contractor. On behalf of _____ ("Subcontractor"), I, the undersigned authorized signatory for Subcontractor, certify to the District and Contractor that [check one]:

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

Or

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

- 1) Subcontractor has obtained all required criminal history record information regarding its covered employees. None of the covered employees has a disqualifying criminal history.
- 2) If Subcontractor receives information that a covered employee subsequently has a reported criminal history, Subcontractor will immediately remove the covered employee from contract duties and notify the District in writing with 3 business days.
- 3) Upon request, Subcontractor 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.

All company employees must have a CFISD badge prior to working on district property.

There is a processing fee of \$7 per badge requested, for which an invoice will be submitted. This fee is a processing fee per individual submitted on the Employee List Form and is charged regardless of whether the individual is approved to receive a badge.

If the District objects to the assignment of a covered employee based on the covered employee's criminal history record information, Subcontractor agrees to discontinue using that covered employee to provide services at the District.

I also certify to the District and Contractor on behalf of Subcontractor that Subcontractor 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.

Signature

Date

Title

Submit completed form to: Cypress-Fairbanks ISD, Facilities & Construction Office: contractor_badges@cfisd.net

Notes

Public work subcontractor employees must have opportunity for *direct contact with students* in order to be subject to a mandatory criminal history review. Tex. Educ. Code § .08341(b)(2). Direct contact with students is contact that results from activities that provide substantial opportunity for verbal or physical interaction with students and that is not supervised by a certified educator or other professional district employee.

For public works subcontractor employees, a person does not have the opportunity for direct contact with students if:

- the public work does not involve the construction, alteration, or repair of an instructional facility;
- if the public work involves construction of a *new* instructional facility, the person's duties related to the contracted services will be completed not later than the seventh day before the first date the facility will be used for instructional purposes; *or*
- if the public work involves an existing instructional facility:
 - the public work area contains sanitary facilities and is separated from all areas used by students by a secure barrier fence that is not less than six feet in height; *and*
 - the contractor adopts a policy prohibiting employees, including subcontractor employees, from interacting with students or entering areas used by students, informs employees of the policy, and enforces the policy at the public work area.

"Instructional facility" means real property, an improvement to real property, or a necessary fixture of an improvement to real property that is used predominantly for teaching the curriculum required under Texas Education Code section 28.002.

FACILITIES PLANNING AND CONSTRUCTION

CERTIFICATE OF FINAL COMPLETION (AQ)

| | | | |
|---------------------------|-----------------------------|--|-----------------|
| Project Name: | 2024 Cy Ridge HS Renovation | Project No.: | 24-02-5752R-RFP |
| Contractor: | | | |
| Contract No.: | 33AC23221 | Contract Date: | |
| Architect/Engineer: | Page Architects | | |
| Date of Final Completion: | | Time of Final Completion (include Time Zone CT): | |

DATE OF FINAL COMPLETION

The work performed under this contract has been inspected and found to be complete. This constitutes the Owner's acceptance for final completion for the **ENTIRE** contract amount. The date of final completion of the project is hereby established as set forth above.

In accordance with the General Conditions and Supplementary Conditions of the contract, this is to confirm the results of the final completion inspection(s). The Contractor has completed the list of items identified on the pre-final and final punch list(s) that the inspection team required corrected or completed before final acceptance of the work in accordance with the contract. Work accepted with incomplete punch list items or failure of the Owner or other parties to identify work that does not comply with the contract documents or is defective in operation or workmanship does not constitute a waiver of the Owner's rights under the contract or relieve the Contractor of its responsibility for performance or warranties.

In accordance with the contract, the date of final completion is that date jointly certified by the Contractor, Architect/Engineer and Owner that the work is completed and the contract is fully satisfied according the contract documents. Completion of all work is a condition precedent to the Contractor's right to receive final payment.

The **CONTRACTOR** has completed/corrected the items identified on all referenced punch list(s) and the requirements of the contract are fully satisfied according to the contract documents.

| | | |
|------------------------|---------------------|---------------|
| _____ | _____ | _____ |
| <i>Project Manager</i> | <i>(Print Name)</i> | <i>(Date)</i> |

The **ARCHITECT** agrees that the work noted in this Certificate of Final Completion is completed in accordance with the contract documents.

| | | |
|--------------------------|---------------------|---------------|
| _____ | _____ | _____ |
| <i>Project Architect</i> | <i>(Print Name)</i> | <i>(Date)</i> |

The **OWNER** accepts the work designated herein to be in accordance with the requirements for final completion, except as provided in the contract documents.

| | | |
|------------------------|---------------------|---------------|
| _____ | _____ | _____ |
| <i>Project Manager</i> | <i>(Print Name)</i> | <i>(Date)</i> |

| | | |
|--|---------------------|---------------|
| _____ | _____ | _____ |
| <i>Director of Construction Field Services</i> | <i>(Print Name)</i> | <i>(Date)</i> |

| | | |
|---------------------------------------|---------------------|---------------|
| _____ | _____ | _____ |
| <i>Director of Project Management</i> | <i>(Print Name)</i> | <i>(Date)</i> |

| | | |
|--|---------------------|---------------|
| _____ | _____ | _____ |
| <i>Director of Contract Management</i> | <i>(Print Name)</i> | <i>(Date)</i> |

| | | |
|---|---------------------|---------------|
| _____ | _____ | _____ |
| <i>Assistant Supt. of Facilities & Construction</i> | <i>(Print Name)</i> | <i>(Date)</i> |

| | | |
|---------------------------------|---------------------|---------------|
| _____ | _____ | _____ |
| <i>Chief Operations Officer</i> | <i>(Print Name)</i> | <i>(Date)</i> |

Associate Supt. of Facilities, Construction & Support Services

SECTION AR

DISCLOSURE OF INTERESTED PARTIES

Section 2252.908 of the Texas Government Code requires a business entity that enters into a contract with a school district must submit a disclosure of interested parties (Form 1295) to the school district and state agency and applies to contracts with a value of \$1,000,000.00 or greater and applies to all contracts entered into on or after January 01, 2016.

An example of the Form 1295 is included in this section; however the form shall be required to be filled out online, printed and signed, and submitted with the contract of which it is applicable.

Filing Process:

By January 01, 2016, the Texas Ethics Commission will make available on its website a new filing application that must be used to file Form 1295. A business entity must use the application to enter the required information on Form 1295 and print a copy of the form and a separate certification of filing that will contain a unique certification number. An authorized agent of the business entity must sign the printed copy of the form and have the form notarized. The completed Form 1295 and certification of filing must be filed with the governmental body or state agency with which the business entity is entering into the contract.

The governmental entity or state agency must notify the commission, using the commission's filing application, of the receipt of the filed Form 1295 and certification of filing not later than the 30th day after the date the contract binds all parties to the contract. The commission will post the completed Form 1295 to its website within seven business days after receiving notice from the governmental entity or state agency.

Information regarding how to use the filing application will be available on the Texas Ethics Commissions site by January 01, 2016 at www.ethics.state.tx.us.



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 10TH day of FEBRUARY in the year 2025
(In words, indicate day, month and year.)

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

Cypress-Fairbanks Independent School District
11430-B Perry Road
Houston, Texas 77064
Telephone: 281-897-4057
Fax: 281-897-3806

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

CONTRACTOR
(TBD)

Telephone:
Fax:

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

2024 CY RIDGE HS RENOVATION
CFISD Project Number: 24-02-5752R-RFP
Architect Project No. 33AC23221

ADDRESS
7900 N. Eldridge Pkwy, Houston, TX 77041

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

PAGE ARCHITECTS
1100 Louisiana Street, Suite One
Houston, TX 77002

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. A vertical line in the left margin of this document indicates where the author has added necessary information and where the author has added to or deleted from the original AIA text.

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.

Init.

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 |
| 10 | INSURANCE AND BONDS |

ARTICLE 1 THE CONTRACT DOCUMENTS

The Contract Documents consist of this Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), all sections of the Project Manual and Construction Documents, Drawings, Specifications, Addenda issued prior to execution of this Agreement, the Contractor's proposal and written amendments or addenda to the proposal, the Contractor's bonds and proof of insurance, other documents listed in this Agreement, Modifications issued after execution of this Agreement, and attached exhibits; these 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.

"Construction Documents" means: all drawings, specifications, submittals, transmittals, deliverables, instructions to Contractors, and other documents, including those in electronic form, prepared by the Architect and the Architect's consultants and which set forth in detail the requirements for construction of the Project.

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. The Contractor may not commence construction, however, until all bonds and insurance required by the Contract Documents have been received by the Owner. All bonds and insurance will be reviewed and approved by the Owner for compliance with the Contract Documents prior to the Contractor mobilizing onsite. Upon Owner approval, the Contractor will be allowed to mobilize onsite.
- Established as follows:
(Insert a date or a means to determine the date of commencement of the Work.)

Init.

/

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.

§ 3.3 The Contractor shall achieve Substantial Completion of the entire Work not later than the date(s) listed below:

(Insert number of calendar days. Alternatively, a calendar date may be used when coordinated with the date of commencement. If appropriate, insert requirements for earlier Substantial Completion of certain portions of the Work.)

| Portion of Work | Substantial Completion Date |
|------------------------|------------------------------------|
| Entire Scope of Work | July 26, 2026 |

subject to adjustments of the Contract Time as provided in the Contract Documents.

(Insert provisions, if any, for liquidated damages relating to failure to achieve Substantial Completion on time or for bonus payments for early completion of the Work.)

Contractor shall achieve buy out of all subcontracts and trades within thirty (30) days following Notice to Proceed.

Contractor shall provide complete Schedule of Values within thirty (30) days following Notice to Proceed.

Liquidated Damages: Refer to AIA Document A201™–2017, General Conditions of the Contract for Construction as amended, Article 8.4.

(Paragraph deleted)

(Table deleted)

(Paragraphs deleted)

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 **XXXX** Dollars (**\$00.00**), subject to additions and deductions as provided in the Contract Documents.

§ 4.1.1 The Contract Sum contains an Owner’s Betterment Allowance in the amount of Two Million Six Hundred Seventy-Three Thousand Nine Hundred Thirty One Dollars and Seventy-Two Cents (**\$2,673,931.72**). This allowance is for the sole use of the Owner to be used for changes in the scope of the Work and for the betterment of the Project. Owner’s authorized representative may approve any expenditure from Owner’s Betterment Allowance without further Board of Trustees approval. If the Owner’s Betterment Allowance is not expended or not fully expended, then any unused portion shall belong to the Owner and shall be credited to the Owner in calculating final payment.

§ 4.2 The Contract Sum is based upon the following alternates, if any, which are described in the Contract Documents and are hereby accepted by the Owner:

(State the numbers or other identification of accepted alternates. If the bidding or proposal documents permit the Owner to accept other alternates subsequent to the execution of this Agreement, attach a schedule of such other alternates showing the amount for each and the date when that amount expires.)

Base Proposal in the amount of.....\$0.00

Total Contract Sum\$0.00

Refer to Exhibit A (includes Base Proposal, Alternate Proposal(s) and Unit Price(s).)

(Table deleted)

(Paragraphs deleted)

(Table deleted)

Init.

(Paragraph deleted)

§ 4.3 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) |
|------|-----------------------|-------------------------|
|------|-----------------------|-------------------------|

Refer to Exhibit A, Form AC – Competitive Sealed Proposal Form, Base Proposal and Alternate Proposal

§ 4.4 Allowances included in the Contract Sum, if any:

(Identify allowance and state exclusions, if any, from the allowance price.)

| Item | Allowance Amount |
|------------------------------|------------------|
| Owner's Betterment Allowance | 2,673,931.72 |

(Paragraphs deleted)

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 at equal one-month intervals. No more than one (1) Application for Payment may be submitted within a given calendar month and shall be submitted to the Owner as required in AIA Document A201™–2017, as amended Article 9.3.6.

§ 5.1.3 The Owner shall make payment of the undisputed, certified amount to the Contractor not later than thirty (30) days after Owner received the Application for Payment, that has been certified by the Architect. If errors are discovered by the Owner in the certified Application for Payment, the Owner shall reject the Application for Payment and return it to the Contractor for correction. The specified time period for payment of such Application for Payment will start over on the date the Owner receives the corrected Application for Payment that has been re-certified by the Architect.

§ 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, unless objected to by the Architect and Owner, 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 Subject to other provisions of the Contract Documents, the amount of each progress payment shall be computed as follows:

- .1 Take that portion of the Contract Sum properly allocable to completed Work as determined by multiplying the percentage completion of each portion of the Work by the share of the Contract Sum allocated to that portion of the Work in the schedule of values, less retainage of five percent (5.0%). Pending final determination of cost to the Owner of changes in the Work, amounts not in dispute shall be included as provided in Section 7.3.8 of AIA Document A201™–2017, General Conditions of the Contract for Construction; as amended;
- .2 Add 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, suitably stored off the site at a location agreed upon in writing), less retainage of five percent (5.0%);
- .3 Subtract the aggregate of previous payments made by the Owner; and
- .4 Subtract amounts, if any, for which the Architect has withheld or nullified a Certificate for Payment as provided in Section 9.5 of AIA Document A201™–2017, as amended.

Init.

(Paragraphs deleted)

§ 5.1.7 The progress payment amount determined in accordance with Section 5.1.6 shall be further modified under the following circumstances:

- .1 Add, upon Substantial Completion of the Work, a sum sufficient to increase the total payments to the full amount of the Contract Sum, less such amounts as the Architect shall determine for incomplete Work, retainage applicable to such work and unsettled claims; and
- .2 Add, if final completion of the Work is thereafter materially delayed through no fault of the Contractor, any additional amounts payable in accordance with Section 9.10.3 of AIA Document A201™–2017, as amended.

(Paragraphs deleted)

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

(If it is intended, prior to Substantial Completion of the entire Work, to reduce or limit the retainage resulting from the percentages inserted in Sections 5.1.6.1 and 5.1.6.2 above, and this is not explained elsewhere in the Contract Documents, insert here provisions for such reduction or limitation.)

The full applicable five percent (5.0%) retainage will be held until Final Completion of the Work associated with the Contract has been achieved.

§ 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 Section 12.2 of AIA Document A201–2017, as amended, and to satisfy other requirements, if any, which extend beyond final payment; and
- .2 a final Certificate for Payment has been issued by the Architect.
- .3 all project close-out documents in their entirety have been completed, submitted to and approved by the Owner.

§ 5.2.2 Upon verification and approval by the Architect and Owner that all Contract requirements have been completed in their entirety, the Contractor shall submit the final Application for Payment to the Architect for approval and certification. Upon receipt of such final Certificate for Payment, the Owner's final payment to the Contractor shall be made no later than thirty (30) days after the issuance of the Architect's final Certificate for Payment, or as follows:

If the Contractor submits the Final Application for Payment to the Architect prior to the verification and approval by the Architect and Owner that the Contractor has completed all Contract requirements, the Architect will return the Application for Final Payment to the Contractor as NOT APPROVED. If errors are discovered by the Owner in the certified Final Application for Payment, the Owner shall reject the Final Application for Payment and return it to the Contractor for correction. The specified time period for payment of such final Application for Payment will start over on the date the Owner receives the corrected final Application for Payment that has been certified by the Architect. Refer to AIA Document A201™–2017, Article 9 as amended.

§ 5.2.3 At the end of the project, after all work is completed according to the Contract Documents, including all closeout documents, the Owner shall release all retainage to the subcontractors, sub-subcontractors and vendors. The retainage for the General Contractor, including, but not limited to, all work self-performed by the General Contractor; and all general condition line items, shall be held until all lien releases have been provided to and accepted by the Owner.

The Owner's final payment to the Contractor shall be made no later than 30 days after the issuance of the Architect's final Certificate for Payment.

§ 5.3 Interest

Payments due and unpaid under the Contract

(Paragraphs deleted)

Init.

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for undisputed amounts shall bear interest pursuant to Texas Prompt Payment Act.

ARTICLE 6 DISPUTE RESOLUTION

§ 6.1

(Paragraphs deleted)

Refer to AIA Document A201–2017, Article 4 as amended. For any Claim or dispute not resolved by the process in Article 4 of AIA Document A201–2017, as amended, the method of binding dispute resolution shall be litigation in a court of competent jurisdiction.

(Paragraphs deleted)

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, as amended.

(Paragraphs deleted)

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

ARTICLE 8 MISCELLANEOUS PROVISIONS

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

§ 8.2 The

(Paragraphs deleted)

Agreement shall be governed by the laws of the State of Texas, and any litigation shall be conducted in state district court. Mandatory and exclusive venue shall be in Harris County, Texas.

§ 8.3

(Paragraphs deleted)

As a material consideration of the making of this Agreement, the modifications to this Agreement shall not be construed against the maker of said modifications.

§ 8.4 Notwithstanding anything to the contrary in this Agreement, or in any document forming a part hereof, there shall be no mandatory arbitration for any dispute arising hereunder.

§ 8.5 The Contractor may not assign its responsibilities, duties, obligations, and rights under this Agreement, without the express written consent of the Owner. This does not prevent Contractor from engaging subcontractors to perform various phases of the Project, but Contractor shall be fully responsible to Owner for the Work, actions, and omissions of all such subcontractors.

(Paragraphs deleted)

§ 8.6

(Paragraphs deleted)

This Agreement, in its entirety, shall be binding upon all the parties hereto, their respective successor, heirs, executors, administrators, or assigns.

§ 8.7 Execution of this Agreement shall constitute approval and acceptance of all terms, covenants, and conditions as modified and contained in the Contract Documents.

§ 8.8 This Agreement is subject to all applicable federal and state laws, rules, and regulations. Invalidity of any portion of this Agreement under the law of the State of Texas or of the United States shall not affect the validity of the remainder of this Agreement.

§ 8.9 Contractor stipulates that Owner is a political subdivision of the State of Texas, and, as such, enjoys immunities from suit and liability as provided by the constitution and laws of the State of Texas. By entering into this Agreement,

Owner does not waive any of its immunities from suit and/or liability, except as otherwise specifically provided herein, and as specifically authorized by law.

§ 8.10 The Owner's representative:
(Name, address, email address, and other information)

Matthew Morgan
Chief Operations Officer/Associate Superintendent
Facilities, Construction & Support Services
Cypress-Fairbanks Independent School District
11440 Matzke Road
Cypress, Texas 77429
Telephone: 281-517-2809
Fax: 281-517-2114

Jesse Clayburn
Assistant Superintendent of Facilities and Construction
Cypress-Fairbanks Independent School District
11440 Matzke Road
Cypress, Texas 77429
Telephone: 281-897-4057
Fax: 281-897-3806

Krystal Ford
Senior Project Manager
Cypress-Fairbanks Independent School District
11430 Perry Road
Houston, Texas 77064
Telephone: 281-517-6862
Fax: 281-897-3806

§ 8.11 The Contractor's representative:
(Name, address, email address, and other information)

§ 8.12 Neither the Owner's nor the Contractor's representative shall be changed without ten (10) days written notice to the other party.

§ 8.13 Other Provisions

§ 8.13.1 All terms "Bidders" and "Bids" are modified to "Proposers" and "Proposals".

§ 8.13.2 Contractor and each subcontractor and sub-subcontractor assigning hereby assigns to Owner any and all claims for overages associated with this Contract which arises under the Antitrust laws of the United States, 15 U.S.C.A. Section 1, et.seq (1973).

ARTICLE 9 ENUMERATION OF CONTRACT DOCUMENTS

§ 9.1

(Paragraphs deleted)

The Contract Documents, except for Modifications issued after execution of this Agreement, are enumerated in the sections below.

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§ 9.1.1 The Agreement is this executed AIA Document A101–2017, Standard Form of Agreement Between Owner and Contractor, as amended.

§ 9.1.2 The General Conditions are AIA Document A201–2017, General Conditions of the Contract for Construction as amended.

| Document | Title | Date | Pages |
|------------|--|------|-------|
| Section CA | Application for Payment Checklist | | |
| Section CB | Supplementary Conditions to the General Conditions of the Contract for Construction as Amended | | |
| Section CC | Right to Audit | | |

§ 9.1.3 The Supplementary and other Conditions of the Contract:

| Document | Title | Date | Pages |
|-----------|--|------|-------|
| Exhibit A | Forms AC, AE, AF, AG, AH, AN and Resumes | | |

(Paragraph deleted)

| Document | Title | Date | Pages |
|-----------|---------------------------------------|------|-------|
| Exhibit B | Front End Documents Table of Contents | | |

§ 9.1.4 The Specifications:

(Either list the Specifications here or refer to an exhibit attached to this Agreement.)

| Section | Title | Date | Pages |
|-----------|----------------------------------|------|-------|
| Exhibit C | Specifications Table of Contents | | |

§ 9.1.5 The Drawings:

(Paragraphs deleted)

(Either list the Drawings here or refer to an exhibit attached to this Agreement.)

| Section | Title | Date | Pages |
|-----------|-------------------|------|-------|
| Exhibit D | Index of Drawings | | |

§ 9.1.6 The Addenda, if any:

| Number | Date | Pages |
|----------------|------|-------|
| Addendum No. 1 | | |

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

§ 9.1.7 Additional documents, if any, forming part of the Contract Documents:

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, as amended provides that bidding requirements such as advertisement or invitation to bid, Instructions to Bidders, sample forms and the Contractor’s bid are not part of the Contract Documents unless enumerated in this Agreement. They should be listed here only if intended to be part of the Contract Documents.)

| Section | Title | Date | Pages |
|-----------|--|------|-------|
| Exhibit E | Section 01 35 23 Special Owner Requirements | | |
| Exhibit F | Post Proposal Addendum No. X (If Applicable) | | |

ARTICLE 10 INSURANCE AND BONDS

§ 10.1 The Contractor shall purchase and maintain insurance and provide bonds as set forth in Article 11 of AIA Document A201–2017, as amended and Section BD of the project specifications.

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

OWNER *(Signature)*

Scott Henry, President of the Board of Trustees or
Administrative Designee
Administrative Designee:
Mr. Matthew Morgan,
Chief Operations Officer/Associate Superintendent
of Facilities, Construction & Support Services

(Printed name and title)

CONTRACTOR *(Signature)*

(Printed name and title)

Additions and Deletions Report for **AIA® Document A101® – 2017**

This Additions and Deletions Report, as defined on page 1 of the associated document, reproduces below all text the author has added to the standard form AIA document in order to complete it, as well as any text the author may have added to or deleted from the original AIA text. Added text is shown underlined. Deleted text is indicated with a horizontal line through the original AIA text.

Note: This Additions and Deletions Report is provided for information purposes only and is not incorporated into or constitute any part of the associated AIA document. This Additions and Deletions Report and its associated document were generated simultaneously by AIA software at 09:51:04 ET on 12/09/2024.

PAGE 1

AGREEMENT made as of the 10TH day of FEBRUARY in the year 2025

...

Cypress-Fairbanks Independent School District
11430-B Perry Road
Houston, Texas 77064
Telephone: 281-897-4057
Fax: 281-897-3806

...

CONTRACTOR
(TBD)

...

Telephone:
Fax:

...

2024 CY RIDGE HS RENOVATION
CFISD Project Number: 24-02-5752R-RFP
Architect Project No. 33AC23221

ADDRESS
7900 N. Eldridge Pkwy, Houston, TX 77041

...

PAGE ARCHITECTS
1100 Louisiana Street, Suite One
Houston, TX 77002

PAGE 2

EXHIBIT A—10 INSURANCE AND BONDS

...

The Contract Documents consist of this Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), all sections of the Project Manual and Construction Documents, Drawings, Specifications, Addenda issued prior to execution of this Agreement, the Contractor's proposal and written amendments or addenda to the proposal, the Contractor's bonds and proof of insurance, other documents listed in this Agreement, and Modifications issued after execution of this Agreement, all of which and attached exhibits; these 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.

"Construction Documents" means: all drawings, specifications, submittals, transmittals, deliverables, instructions to Contractors, and other documents, including those in electronic form, prepared by the Architect and the Architect's consultants and which set forth in detail the requirements for construction of the Project.

...

[] A date set forth in a notice to proceed issued by the Owner. The Contractor may not commence construction, however, until all bonds and insurance required by the Contract Documents have been received by the Owner. All bonds and insurance will be reviewed and approved by the Owner for compliance with the Contract Documents prior to the Contractor mobilizing onsite. Upon Owner approval, the Contractor will be allowed to mobilize onsite.

PAGE 3

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

§ 3.3 The Contractor shall achieve Substantial Completion of the entire Work not later than the date(s) listed below:

(Insert number of calendar days. Alternatively, a calendar date may be used when coordinated with the date of commencement. If appropriate, insert requirements for earlier Substantial Completion of certain portions of the Work.)

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

| | |
|----------------------|---------------|
| Entire Scope of Work | July 26, 2026 |
|----------------------|---------------|

subject to adjustments of the Contract Time as provided in the Contract Documents.

(Insert provisions, if any, for liquidated damages relating to failure to achieve Substantial Completion on time or for bonus payments for early completion of the Work.)

Contractor shall achieve buy out of all subcontracts and trades within thirty (30) days following Notice to Proceed.

Contractor shall provide complete Schedule of Values within thirty (30) days following Notice to Proceed.

Liquidated Damages: Refer to AIA Document A201™-2017, General Conditions of the Contract for Construction as amended, Article 8.4.

§ 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:

§ 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

§ 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.

§ 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 (\$—), **XXXX** Dollars (**\$00.00**), subject to additions and deductions as provided in the Contract Documents.

§ 4.1.1 The Contract Sum contains an Owner’s Betterment Allowance in the amount of Two Million Six Hundred Seventy-Three Thousand Nine Hundred Thirty One Dollars and Seventy-Two Cents (**\$2,673,931.72**). This allowance is for the sole use of the Owner to be used for changes in the scope of the Work and for the betterment of the Project. Owner’s authorized representative may approve any expenditure from Owner’s Betterment Allowance without further Board of Trustees approval. If the Owner’s Betterment Allowance is not expended or not fully expended, then any unused portion shall belong to the Owner and shall be credited to the Owner in calculating final payment.

§ 4.2 Alternates The Contract Sum is based upon the following alternates, if any, which are described in the Contract Documents and are hereby accepted by the Owner:

(State the numbers or other identification of accepted alternates. If the bidding or proposal documents permit the Owner to accept other alternates subsequent to the execution of this Agreement, attach a schedule of such other alternates showing the amount for each and the date when that amount expires.)

Base Proposal in the amount of.....\$0.00

Total Contract Sum\$0.00

Refer to Exhibit A (includes Base Proposal, Alternate Proposal(s) and Unit Price(s).)

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

Item Price

§ 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

§ 4.3 Allowances, if any, included in the Contract Sum:

(Identify each allowance.) 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 Price

Item Units and Limitations Price per Unit (\$0.00)

Refer to Exhibit A, Form AC – Competitive Sealed Proposal Form, Base Proposal and Alternate Proposal

§ 4.4 Unit prices, Allowances included in the Contract Sum, if any:

(Identify the item and state the unit price and quantity limitations, if any, to which the unit price will be applicable.) allowance and state exclusions, if any, from the allowance price.)

Item Units and Limitations Price per Unit (\$0.00)

| <u>Item</u> | <u>Allowance Amount</u> |
|-------------------------------------|-------------------------|
| <u>Owner's Betterment Allowance</u> | <u>2,673,931.72</u> |

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

~~§ 4.6~~ Other:
(Insert provisions for bonus or other incentives, if any, that might result in a change to the Contract Sum.)

PAGE 4

~~§ 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:~~

at equal one-month intervals. No more than one (1) Application for Payment may be submitted within a given calendar month and shall be submitted to the Owner as required in AIA Document A201™-2017, as amended Article 9.3.6.

~~§ 5.1.3~~ ~~Provided that an Application for Payment is received by the Architect not later than the day of a month, the~~
The Owner shall make payment of the undisputed, certified amount certified to the Contractor not later than the day of the 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 () days after the Architect receives the Application for Payment.

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

(30) days after Owner received the Application for Payment, that has been certified by the Architect. If errors are discovered by the Owner in the certified Application for Payment, the Owner shall reject the Application for Payment and return it to the Contractor for correction. The specified time period for payment of such Application for Payment will start over on the date the Owner receives the corrected Application for Payment that has been re-certified by the Architect.

~~§ 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 schedule, unless objected to by the Architect and Owner, shall be used as a basis for reviewing the Contractor's Applications for Payment.~~

...

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

- .1 Take that portion of the Contract Sum properly allocable to completed Work as determined by multiplying the percentage completion of each portion of the Work by the share of the Contract Sum allocated to that portion of the Work in the schedule of values, less retainage of five percent (5.0%). Pending final determination of cost to the Owner of changes in the Work, amounts not in dispute shall be included as provided in Section 7.3.8 of AIA Document A201™-2017, General Conditions of the Contract for Construction; as amended;
- .2 Add 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, suitably stored off the site at a location agreed upon in writing), less retainage of five percent (5.0%);
- .3 Subtract the aggregate of previous payments made by the Owner; and

4 Subtract amounts, if any, for which the Architect has withheld or nullified a Certificate for Payment as provided in Section 9.5 of AIA Document A201™–2017, as amended.

§ 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 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, 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 The progress payment amount determined in accordance with Section 5.1.6 shall be further modified under the following circumstances:

- .1 Add, upon Substantial Completion of the Work, a sum sufficient to increase the total payments to the full amount of the Contract Sum, less such amounts as the Architect shall determine for incomplete Work, retainage applicable to such work and unsettled claims; and
- .2 Add, if final completion of the Work is thereafter materially delayed through no fault of the Contractor, any additional amounts payable in accordance with Section 9.10.3 of AIA Document A201™–2017, as amended.

§ 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.)

§ 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.)

§ 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.)

§ 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.)

~~§ 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. Reduction or limitation of retainage, if any, shall be as follows:
(If it is intended, prior to Substantial Completion of the entire Work, to reduce or limit the retainage resulting from the percentages inserted in Sections 5.1.6.1 and 5.1.6.2 above, and this is not explained elsewhere in the Contract Documents, insert here provisions for such reduction or limitation.)~~

~~The full applicable five percent (5.0%) retainage will be held until Final Completion of the Work associated with the Contract has been achieved.~~

PAGE 5

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

- ~~.1 the Contractor has fully performed the Contract except for the Contractor's responsibility to correct Work as provided in ~~Article 12~~ Section 12.2 of AIA Document A201–2017, as amended, and to satisfy other requirements, if any, which extend beyond final payment; and~~
- ~~.2 a final Certificate for Payment has been issued by the Architect.~~
- ~~.3 all project close-out documents in their entirety have been completed, submitted to and approved by the Owner.~~

~~§ 5.2.2 The Upon verification and approval by the Architect and Owner that all Contract requirements have been completed in their entirety, the Contractor shall submit the final Application for Payment to the Architect for approval and certification. Upon receipt of such final Certificate for Payment, the Owner's final payment to the Contractor shall be made no later than ~~30~~ thirty (30) days after the issuance of the Architect's final Certificate for Payment, or as follows:~~

~~If the Contractor submits the Final Application for Payment to the Architect prior to the verification and approval by the Architect and Owner that the Contractor has completed all Contract requirements, the Architect will return the Application for Final Payment to the Contractor as NOT APPROVED. If errors are discovered by the Owner in the certified Final Application for Payment, the Owner shall reject the Final Application for Payment and return it to the Contractor for correction. The specified time period for payment of such final Application for Payment will start over on the date the Owner receives the corrected final Application for Payment that has been certified by the Architect. Refer to AIA Document A201™–2017, Article 9 as amended.~~

~~§ 5.2.3 At the end of the project, after all work is completed according to the Contract Documents, including all closeout documents, the Owner shall release all retainage to the subcontractors, sub-subcontractors and vendors. The retainage for the General Contractor, including, but not limited to, all work self-performed by the General Contractor; and all general condition line items, shall be held until all lien releases have been provided to and accepted by the Owner.~~

~~The Owner's final payment to the Contractor shall be made no later than 30 days after the issuance of the Architect's final Certificate for Payment.~~

~~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.)~~

~~—%— for undisputed amounts shall bear interest pursuant to Texas Prompt Payment Act.~~

PAGE 6

§ 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.)~~

Refer to AIA Document A201–2017, Article 4 as amended. For any Claim or dispute not resolved by the process in Article 4 of AIA Document A201-2017, as amended, the method of binding dispute resolution shall be litigation in a court of competent jurisdiction.

§ 6.2 Binding Dispute Resolution

For any Claim subject to, but not resolved 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.

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

§ 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:

(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~~A201–2017, as amended.

...

§ 8.1 Where reference is made in this Agreement to a provision of AIA Document ~~A201–2017~~A201–2017, as amended 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)

Agreement shall be governed by the laws of the State of Texas, and any litigation shall be conducted in state district court. Mandatory and exclusive venue shall be in Harris County, Texas.

§ 8.3 The Contractor’s representative:

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

As a material consideration of the making of this Agreement, the modifications to this Agreement shall not be construed against the maker of said modifications.

§ 8.4 Neither the Owner's nor the Contractor's representative shall be changed without ten days' prior notice to the other party. Notwithstanding anything to the contrary in this Agreement, or in any document forming a part hereof, there shall be no mandatory arbitration for any dispute arising hereunder.

§ 8.5 Insurance and Bonds The Contractor may not assign its responsibilities, duties, obligations, and rights under this Agreement, without the express written consent of the Owner. This does not prevent Contractor from engaging subcontractors to perform various phases of the Project, but Contractor shall be fully responsible to Owner for the Work, actions, and omissions of all such subcontractors.

§ 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, if completed, or as otherwise set forth below:
(If other than in accordance with a building information modeling exhibit, 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.)

This Agreement, in its entirety, shall be binding upon all the parties hereto, their respective successor, heirs, executors, administrators, or assigns.

§ 8.7 Other provisions:

Execution of this Agreement shall constitute approval and acceptance of all terms, covenants, and conditions as modified and contained in the Contract Documents.

§ 8.8 This Agreement is subject to all applicable federal and state laws, rules, and regulations. Invalidation of any portion of this Agreement under the law of the State of Texas or of the United States shall not affect the validity of the remainder of this Agreement.

§ 8.9 Contractor stipulates that Owner is a political subdivision of the State of Texas, and, as such, enjoys immunities from suit and liability as provided by the constitution and laws of the State of Texas. By entering into this Agreement, Owner does not waive any of its immunities from suit and/or liability, except as otherwise specifically provided herein, and as specifically authorized by law.

§ 8.10 The Owner's representative:
(Name, address, email address, and other information)

Matthew Morgan
Chief Operations Officer/Associate Superintendent
Facilities, Construction & Support Services
Cypress-Fairbanks Independent School District
11440 Matzke Road
Cypress, Texas 77429
Telephone: 281-517-2809
Fax: 281-517-2114

Jesse Clayburn
Assistant Superintendent of Facilities and Construction
Cypress-Fairbanks Independent School District
11440 Matzke Road
Cypress, Texas 77429
Telephone: 281-897-4057
Fax: 281-897-3806

Krystal Ford
Senior Project Manager
Cypress-Fairbanks Independent School District
11430 Perry Road
Houston, Texas 77064
Telephone: 281-517-6862
Fax: 281-897-3806

§ 8.11 The Contractor's representative:
(Name, address, email address, and other information)

§ 8.12 Neither the Owner's nor the Contractor's representative shall be changed without ten (10) days written notice to the other party.

§ 8.13 Other Provisions

§ 8.13.1 All terms "Bidders" and "Bids" are modified to "Proposers" and "Proposals".

§ 8.13.2 Contractor and each subcontractor and sub-subcontractor assigning hereby assigns to Owner any and all claims for overages associated with this Contract which arises under the Antitrust laws of the United States, 15 U.S.C.A. Section 1, et.seq (1973).

§ 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.)The Contract Documents, except for Modifications issued after execution of this Agreement, are enumerated in the sections below.

§ 9.1.1 The Agreement is this executed AIA Document A101–2017, Standard Form of Agreement Between Owner and Contractor, as amended.

.5 — Drawings
§ 9.1.2 The General Conditions are AIA Document A201–2017, General Conditions of the Contract for Construction as amended.

| <u>Number</u> | <u>Title</u> | <u>Date</u> | <u>Pages</u> |
|-------------------|--|-------------|--------------|
| <u>Document</u> | <u>Title</u> | <u>Date</u> | <u>Pages</u> |
| <u>Section CA</u> | <u>Application for Payment Checklist</u> | | |
| <u>Section CB</u> | <u>Supplementary Conditions to the General Conditions of the Contract for Construction</u> | | |

as Amended

Section CC Right to Audit

.6 Specifications

§ 9.1.3 The Supplementary and other Conditions of the Contract:

| <u>Section</u> | <u>Document</u> | <u>Title</u> | <u>Date</u> | <u>Pages</u> |
|----------------|-----------------|--|-------------|--------------|
| | Exhibit A | Forms AC, AE, AF, AG, AH, AN and Resumes | | |

.7 Addenda, if any:

| <u>Number</u> | <u>Date</u> | <u>Pages</u> | |
|-----------------|---------------------------------------|--------------|--------------|
| <u>Document</u> | <u>Title</u> | <u>Date</u> | <u>Pages</u> |
| Exhibit B | Front End Documents Table of Contents | | |

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. § 9.1.4 The Specifications: (Either list the Specifications here or refer to an exhibit attached to this Agreement.)

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

| <u>Section</u> | <u>Title</u> | <u>Date</u> | <u>Pages</u> |
|----------------|----------------------------------|-------------|--------------|
| Exhibit C | Specifications Table of Contents | | |

§ 9.1.5 The Drawings:

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

(Either list the Drawings here or refer to an exhibit attached to this Agreement.)

| <input type="checkbox"/> | <u>Title</u> | <u>Date</u> | <u>Pages</u> |
|--------------------------|--------------------------|-------------|--------------|
| <input type="checkbox"/> | The Sustainability Plan: | | |
| <u>Section</u> | <u>Title</u> | <u>Date</u> | <u>Pages</u> |
| Exhibit D | Index of Drawings | | |

Supplementary and other Conditions of the Contract: § 9.1.6 The Addenda, if any:

| <u>Document</u> | <u>Title</u> | <u>Date</u> | <u>Pages</u> |
|-----------------|--------------|-------------|--------------|
| <u>Number</u> | | <u>Date</u> | <u>Pages</u> |
| Addendum No. 1 | | | |

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

§ 9.1.7 Additional documents, if any, forming part of the Contract Documents:

(List here any additional documents that are intended to form part of the Contract Documents. AIA Document A201™ 2017 provides that the A201-2017, as amended provides that bidding requirements such as 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, forms and the Contractor's bid are not part of the Contract Documents unless enumerated in this Agreement. Any such documents They should be listed here only if intended to be part of the Contract Documents.)

| <u>Section</u> | <u>Title</u> | <u>Date</u> | <u>Pages</u> |
|------------------|---|-------------|--------------|
| <u>Exhibit E</u> | <u>Section 01 35 23 Special Owner Requirements</u> | | |
| <u>Exhibit F</u> | <u>Post Proposal Addendum No. X (If Applicable)</u> | | |

ARTICLE 10 INSURANCE AND BONDS

§ 10.1 The Contractor shall purchase and maintain insurance and provide bonds as set forth in Article 11 of AIA Document A201–2017, as amended and Section BD of the project specifications.

PAGE 9

Scott Henry, President of the Board of Trustees or
Administrative Designee
Administrative Designee:
Mr. Matthew Morgan,
Chief Operations Officer/Associate Superintendent
of Facilities, Construction & Support Services

Certification of Document's Authenticity

AIA® Document D401™ – 2003

I, _____, hereby certify, to the best of my knowledge, information and belief, that I created the attached final document simultaneously with its associated Additions and Deletions Report and this certification at 09:51:04 ET on 12/09/2024 under Order No. 2114467101 from AIA Contract Documents software and that in preparing the attached final document I made no changes to the original text of AIA® Document A101™ – 2017, Standard Form of Agreement Between Owner and Contractor where the basis of payment is a Stipulated Sum, other than those additions and deletions shown in the associated Additions and Deletions Report.

(Signed)

(Title)

(Dated)



AIA® Document A201® – 2017

General Conditions of the Contract for Construction

for the following PROJECT:

(Name and location or address)

2024 Cy Ridge HS Renovation
CFISD Project Number: 24-02-5752R-RFP
Architect Project No. 33AC23221

CAMPUS ADDRESS:

7900 N. Eldridge Pkwy., Houston, Texas 77041

THE OWNER:

(Name, legal status and address)

Cypress-Fairbanks Independent School District
11430-B Perry Road
Houston, Texas 77064
Telephone Number: 281-897-4108
Fax Number: 281-897-3806

THE ARCHITECT:

(Name, legal status and address)

Page Architects
1100 Louisiana Street, Suite One
Houston, Texas 77002

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- 1 GENERAL PROVISIONS
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- 3 CONTRACTOR
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- 6 CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS
- 7 CHANGES IN THE WORK
- 8 TIME
- 9 PAYMENTS AND COMPLETION
- 10 PROTECTION OF PERSONS AND PROPERTY
- 11 INSURANCE AND BONDS

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. A vertical line in the left margin of this document indicates where the author has added necessary information and where the author has added to or deleted from the original AIA text.

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

For guidance in modifying this document to include supplementary conditions, see AIA Document A503™, Guide for Supplementary Conditions.

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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 as amended (hereinafter the Agreement) and consist of the Agreement, Conditions of the Contract, as amended (General, Supplementary and other Conditions), Performance Bond, Labor and Materials Payment Bond and Proof of Insurance, Contractor's Proposal, Drawings, Specifications, all Addenda issued prior to execution of 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 a Change Proposal Request, or (4) a written order for a minor change in the Work issued by the Architect.

§ 1.1.2 The Contract

The Contract Documents form the Contract for Construction. This agreement, as amended, represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations, or agreements, either written or oral. The Construction Documents become part of the Contract when accepted by the Owner. All sections of the Project Manual shall be a part of the Contract, including any Proposal signed by the Contractor, and any Request for Proposals for the Project ("RFP"). The Contract may be amended or modified only by a written Modification signed by the Owner. 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 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.

It also includes all supplies, skill, supervision, transportation services, storage requirements and other facilities and things necessary, proper or incidental to the carrying out and completion of the terms of the contract and all other items of cost or value needed to produce, construct and fully complete the public work identified by the Contract Documents.

§ 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.

(Paragraphs deleted)

§ 1.1.7 The Project Manual

The Project Manual is a volume assembled for the Work which may include the bidding or proposal requirements, sample forms, Conditions of the Contract and Specifications.

§ 1.1.8 Addenda

Addenda are written or graphic instruments issued prior to the execution of the Contract which modify or interpret the Proposal Documents, including Drawings and Specifications, by additions, deletions, clarifications or corrections. Addenda will become part of the Contract Documents when the Construction agreement is executed. The successful Contractor and his Subcontractors shall post all addendum items on their sets of Drawings and Specifications.

§ 1.1.9 Approved Equal, Approved Equivalent or Equal

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The terms Approved and Approved Equivalent relate to the substitution of products or systems approved in writing by the Architect. Refer to Paragraph 3.19 Substitution of Products and Systems for procedure which must be followed.

§ 1.1.10 Proposal Documents

Proposal Documents consist of all documents bound into or referenced in the Project Manual, the Drawings, and Addenda related thereto. The Project Manual contains the Proposal Requirements, Sample Forms, Conditions of the Contract, the Specifications, and a list of Drawings, and Schedules, some of which are bound into the Project Manual (Other Drawings and Schedules are bound separately).

§ 1.1.11 Miscellaneous Other Words

The terms "Bids" or "Bidding" mean Competitive Sealed Proposal, which by definition allows the Owner to accept the "best value" for the school district, based on factors other than cost.

§ 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.

(Paragraph deleted)

§ 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 recent issued Document takes precedence over the previous issued forms of the same Document. The order of precedence is as follows with the highest authority listed first.

- .1 The Agreement
- .2 The Addenda
- .3 Conditions of the Contract, Drawings and Specifications shall have equal authority. Should these documents disagree in themselves, the Architect will select the appropriate method for performing the work at no additional increase in the Contract Cost.

In the case of an inconsistency between the Drawings and Specifications or within either set of Documents discovered prior to Proposal Time but too late to be clarified by an Addendum, the better quality or greater quantity of work shall be included in the proposal. Clarification of the inconsistency will be accomplished with Contractor after award of the Contract, and if necessary, an appropriate reduction in the Contract will be accomplished by Change Order.

§ 1.2.5 Relation of Specifications and Drawings

The Drawings and Specifications are correlative and have equal authority and priority. Should they disagree in themselves, or with each other, base the proposals on the most expensive combination of quality or quantity of work indicated. The appropriate method of performing the Work, in the event of the above-mentioned disagreements, will be made by the Architect.

§ 1.2.6 Optional Materials, Brands and Processes

When more than one is specified for a particular item of Work, the choice shall be the Contractor's. The final selection of color and pattern will be made by the Architect from the range available within the option selected by the Contractor, unless the item is specified to match a specific color or sample furnished. Where particular items are specified only products of those named manufacturers are acceptable. Certain specified construction and equipment details may not be regularly included as part of the named manufacturer's standard catalog equipment but shall be provided by the manufacturer as required for the proper functioning of the equipment. Reasonable minor variations in equipment are expected and will be acceptable; however, indicated and specified performance and material requirements are minimum, and will be required in addition to standard accessories. The Architect reserves the right to determine the equality of equipment and materials that deviate from any of the indicated and specified requirements.

§ 1.2.7 Standards and Requirements

When the Contract Documents refer to standards, building codes, manufacturers' instructions, or other documents, unless otherwise specified, then the current edition as of the date of execution of the Agreement by the last party to execute said Agreement shall apply. It shall be the responsibility of the Architect to address revisions or amendments to applicable codes or standards which arise after the date of execution of the Agreement and until Final Completion, pursuant to the terms of the Agreement between Owner and Architect. Requirements of public authorities apply as minimum requirements only and do not supersede more stringent 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 Execution of Contract Documents

§ 1.5.1 The Contract Documents shall be signed by the Owner and Contractor. If either the Owner or Contractor or both do not sign all the Contract Documents, the Architect shall identify such unsigned Documents upon request.

§ 1.5.2 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 to the Contract Documents. If an approved Contract Document requiring Contractor's signature has not been signed, then the missing signature shall be provided within a reasonable period of time. Failure of Contractor to sign an approved Contract Document after notice and a reasonable opportunity to sign, shall be considered a material breach of the Contract by Contractor.

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

§ 1.6.1 The Drawings, Specifications and other documents, including those in electronic form, prepared by the Architect and the Architect's consultants are Construction Documents through which the Work to be executed by the Contractor is described. All ownership rights, whether common law, statutory, or other reserved rights, including copyright ownership of the Construction Documents, are controlled by the Agreement between the Owner and Architect. The Contractor may retain one record set. Neither the Contractor nor any Subcontractor, Sub-subcontractor or material or equipment supplier shall own or claim a copyright in the Drawings, Specifications and other documents prepared by the Architect or the Architect's consultants. The Drawings, Specifications and other documents prepared by the Architect and the Architect's consultants, and copies thereof furnished to the Contractor, are for use solely with respect to this Project. They are not to be used by the Contractor or any Subcontractor, Sub-subcontractor or material or equipment supplier on other projects or for additions to this Project outside the scope of the Work without the specific written consent of the Owner. The Contractor, Subcontractors, Sub-subcontractors and material or equipment suppliers are authorized to use and reproduce applicable portions of the Drawings, Specifications and other documents prepared by the Architect and the Architect's consultants appropriate to and for use in the execution of their Work under the Contract Documents. All copies made under this authorization shall bear the statutory copyright notice, if any, shown on the Drawings, Specifications and other documents prepared by the Architect and the Architect's consultants. Submittal or distribution to meet official regulatory requirements or for other purposes in connection with this Project is not to be construed as publication in derogation of any copyrights or other reserved rights.

(Paragraphs deleted)

§ 1.7 Miscellaneous Other Definitions

§ 1.7.1 Alternate Proposal(s)

A separate amount stated on the 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 a period of 120 days after receipt of proposals, unless otherwise modified, regardless if an Owner Contractor Agreement has been executed, unless indicated otherwise herein.

§ 1.7.2 Base Proposal

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

§ 1.7.3 Contract Time

The period of time which is established in the Contract Documents for Substantial Completion of the Work. This period of time is not subject to adjustment or extension without the written permission of the Owner.

§ 1.7.4 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.

§ 1.7.5 Date of Commencement of the Work

The commencement date shall be the date the contract award is approved by the CFISD Board of Trustees. This date constitutes day zero ("0") of Contract Time.

§ 1.7.6 Date of Final Completion

The end of construction. Refer to Section 9.10.

§ 1.7.7 Day

The following days are referenced in the documents:

- .1 Calendar Days: The days of the Gregorian Calendar. The Contract Time is established in Calendar Days and extensions of time granted for Regular Work Days lost, in excess of anticipated delay day allowance, will be converted to Calendar Days.
- .2 Holidays: The days officially recognized by the construction industry and/or Owner approved holidays, in this area as a holiday; normally limited to the observance days of New Year's Day, Martin Luther King, Jr. Day, Good Friday, Memorial Day, Fourth of July, Labor Day, Thanksgiving Day and the Friday after, Christmas Eve, Christmas Day and New Year's Eve day.
- .3 Regular Work Days: All calendar days except holidays, Saturdays, and Sundays. Requests for extensions of time shall be requested, after expenditure of the Anticipated Delay Day Allowance, on the basis of Regular Work Days, and those days, if approved; will be converted to calendar days by multiplying by a factor of one and four-tenths (1.4). The Contractor is advised to refer to Section 01 35 23.1, Special Owner Requirements regarding after hours use of the premises.
- .4 Anticipated Delay Days Allowance: An allowance of Fifteen (15) Regular Work Days per year (or two (2) regular work days per month, whichever is less) is established as probable days lost due to delays beyond the Contractor's control. This allowance includes District testing dates and any other days the district directs the contractor to not perform work due to unspecified campus events. This additional Delay day allowance does not include anticipated weather days as indicated in section 8.3., also does not include Holidays as indicated in Section 1.7.7.2. These days for weather and holidays are to be added to this additional delay day allowance and are to be calculated in accordance with their respective section as indicated elsewhere in these general conditions to establish the grand total of the anticipated delay day allowance.
- .5 Evaluation of Delay Days: The Architect and Owner will evaluate delays claimed by the Contractor based on the Critical Path of the Contractor's construction schedule, and if the Architect is in agreement that a Critical Path task has been delayed due to circumstances beyond the Contractor's control, the accepted delay days will be deducted from the Anticipated Delay Day Allowance.
- .6 Delay Days: Regular Work Days when circumstances beyond the Contractor's control prevent progress on major portions of the Work as described in Paragraph 8.3, Delays and Extensions of Time, in the General Conditions of the Contract for Construction.

§ 1.7.8 Notice to Proceed

A notice that may be given on behalf of the Owner to the Contractor, through the Architect, that directs the Contractor to start the Work. It also establishes the Date of Commencement of the Work.

§ 1.7.9 Provide

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

§ 1.7.10 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. Refer to Article 9.8.

ARTICLE 2 OWNER

§ 2.1 General

§ 2.1.1 The Owner is the independent school district identified in the Contract Documents. The Board of Trustees, by majority vote, is the only representative of the Owner, an independent school district, having the power to: enter into a contract; amend a contract; approve changes in the scope of the Work; approve and execute a Change Order or Construction Change Directive modifying the Contract Sum; agree to an extension to the date of Substantial or Final Completion; or terminate a contract. The Board designates authorized representatives to act on its behalf for day-to-day operations under the Contract. Unless otherwise designated in the Contract Documents, Owner's authorized representative shall be the Superintendent of Schools, who may delegate responsibilities as appropriate. Owner's Board of Trustees hereby delegates to the Superintendent of Schools or designee the authority to approve changes to the Work where such changes are within the Owner's Betterment Allowance or other designated Allowances stipulated in the Contract Documents and also the authority to approve any Change Order which does not exceed \$249,999.99 and the authority to approve any and all time extensions to the Contract. Any Change Order that is valued at or above \$250,000 shall require Board approval in accordance with Local Board Policy. Except as otherwise provided in the Contract Documents, the Architect does not have such authority. Neither Architect nor Contractor may rely upon the direction of any employee of Owner who has not been designated in writing in the Contract Documents. Owner shall not be financially responsible for actions taken by the Architect or Contractor in reliance upon direction from unauthorized persons.

§ 2.1.2 It shall be distinctly understood that by virtue of this Contract, neither the Contractor nor any contractor, subcontractor, sub-subcontractor, consultant, design professional, mechanic, material person, artisan, or laborer, skilled or unskilled, shall ever in any manner have, claim, or acquire any lien upon the buildings or any of the improvements of whatsoever nature or kind so erected or to be erected by virtue of this Contract or upon any of the land on which said buildings or any of the improvements are so erected, built, or situated. It shall be further understood that this Contract is not written for the benefit of third parties nor shall it be construed to create any third party beneficiaries.

§ 2.2 Information and Services Required of the Owner

§ 2.2.1 Prior to commencement of the Work, the Contractor may request in writing that the Owner provide reasonable evidence that the Owner has made financial arrangements to fulfill the Owner's obligations under the Contract. Thereafter, the Contractor may only request such evidence if (1) the Owner fails to make payments to the Contractor as the Contract Documents require; (2) a change in the Work materially changes the Contract Sum; or (3) the Contractor identifies in writing a reasonable concern regarding the Owner's ability to make payment when due. The Owner shall furnish such evidence as a condition precedent to commencement or continuation of the Work or the portion of the Work affected by a material change. After the Owner furnishes the evidence, the Owner shall not materially vary such financial arrangements without prior notice to the Contractor.

§ 2.2.2 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.

§ 2.2.3 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 reasonably rely on the accuracy of information furnished by the Owner but shall exercise proper precautions relating to the safe performance of the Work, shall exercise due diligence in attempting to locate underground utilities, and shall notify the Owner and Architect of any discrepancies between the surveys and actual conditions of the site that Contractor observes or should observe in the exercise of ordinary care.

§ 2.2.4 The Owner shall furnish 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.

§ 2.2.5 Refer to Section CB, Supplementary Conditions, for quantities of plans and project specifications to be furnished to the Contractor.

§ 2.3 Owner's Right to Stop the Work

(Paragraphs deleted)

§ 2.3.1 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 Owner's Right to Carry Out the Work

§ 2.4.1 If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents and fails within seven (7) Calendar Days after receipt of written 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, immediately correct such deficiencies. In such case an appropriate Change Order shall be issued deducting from payments then or thereafter due the Contractor 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. Such action by the Owner and amounts charged to the Contractor are both subject to prior approval of the Architect. If payments then or thereafter due the Contractor are not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner.

§ 2.5 Owner's Right to Occupy the Project

§ 2.5.1 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 have expired. Such occupancy and use shall not constitute acceptance of any work not in accordance with the Contract Documents and Contractor shall be responsible for insurance, utilities and security until Substantial Completion of the entire project.

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

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 in a good and workmanlike manner and in an expeditious and economical manner consistent with the interest of the Owner; shall exercise the degree of care, skill, and diligence in the performance of the Work in accordance with and consistent with industry standards for similar projects; shall utilize its best skill, effort, and judgment in diligently performing the Work; and shall furnish efficient business administration and supervision. Workmanship shall be of a quality to produce satisfactory results.

§ 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 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 The Contractor shall carefully study and compare the Agreement, Conditions of the Contract, Drawings, Specifications, Addenda, Modifications, and information provided by the Owner and shall at once report to the Architect any error, inconsistency, or omission he may discover. Contractor shall be liable for any damage to Owner for failure to report any error, inconsistency or omission he may discover or should have discovered, but he shall not be liable to Owner or Architect for any damage resulting for such error, inconsistency or omission which he did discover and at once so reported. Contractor shall not perform any work without approved Drawings and Specifications issued by the Architect.

§ 3.2.2 Any design errors or omissions noted by the Contractor during this review shall be reported promptly to the Architect, but 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. The Contractor is not required to ascertain that the Contract Documents are in accordance with applicable laws, statutes, ordinances, building codes, and rules and regulations, but any nonconformity discovered by or made known to the Contractor shall be reported promptly to the Architect.

§ 3.2.3 If the Contractor believes that additional cost or time is involved because of clarifications or instructions issued by the Architect in response to the Contractor's notices or requests for information pursuant to Sections 3.2.1 and 3.2.2, the Contractor shall make Claims as provided in Sections 4.3.6 and 4.3.7. If the Contractor fails to perform the obligations of Sections 3.2.1 and 3.2.2, the Contractor shall pay such costs and damages to the Owner as would have been avoided if the Contractor had performed such obligations. The Contractor shall not be liable to the Owner or Architect for damages resulting from errors, inconsistencies or omissions in the Contract Documents or for differences between field measurements or conditions and the Contract Documents unless the Contractor recognized such error, inconsistency, omission or difference and knowingly failed to report it to the Architect.

(Paragraphs deleted)

§ 3.2.4 The Contractor shall take field measurements and verify field conditions and shall carefully compare such fields measurements and conditions and other information known to the Contractor with the Contract documents before commencing activities. Errors, inconsistencies or omissions discovered shall be reported to the Architect at once.

§ 3.2.5 The Contractor shall not be entitled to additional compensation for the "rework portion" of any additional work caused by his failure to carefully study and compare the contract documents prior to execution of the Work.

§ 3.2.6 The Contractor shall make a reasonable attempt to interpret the Contract Documents before asking the Architect for assistance in interpretation. The Contractor shall not ask the Architect for observation of work prior to the Contractor's field superintendent's personal inspection of the work and his determination that the work complies with the Contract Documents. The Contractor shall arrange meetings prior to commencement of the work of all major subcontractors to allow the subcontractor to demonstrate his understanding of the documents to the Architect/Owner and to allow the subcontractor to ask for any interpretation he may require.

§ 3.2.7 If, in the opinion of the architect, the Contractor does not make a reasonable effort to comply with the above requirements of the Contract Documents and this causes the Architect or his Consultants to expend an unreasonable amount of time in the discharge of the duties imposed on him by the Contract Documents, then the Contractor shall bear the cost of compensation for the Architect's additional services made necessary by such failure. The Architect will give the Contractor prior notice of intent to bill for additional services related to above requirements before additional services are performed.

§ 3.2.8 If the Contractor has knowledge that any of the products or systems specified will perform in a manner that will limit the Contractor's ability to satisfactorily perform the work or to honor his Warranty, he shall promptly notify the Architect in writing, providing substantiation for his position. Any necessary changes, including substitution of materials, shall be accomplished by appropriate Modification.

§ 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, unless the Contract Documents give other specific instructions concerning these matters. If the Contract Documents give specific instructions concerning

construction means, methods, techniques, sequences or procedures, the Contractor shall evaluate the jobsite safety thereof and, except as stated below, shall be fully and 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 written notice to the Owner and Architect and shall not proceed with that portion of the Work without further written instructions from the Architect. If the Contractor is then instructed to proceed with the required means, methods, techniques, sequences or procedures without acceptance of changes proposed by the Contractor, the Contractor shall not be responsible for any resulting loss or damage arising solely from those Owner-required means, methods, techniques, sequences or procedures.

§ 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.

§ 3.3.3.1 The Contractor is especially cautioned to coordinate the routing of all mechanical, plumbing and electrical items and provide coordinating drawings in accordance with provisions of the Contract Documents prior to commencing these operations.

§ 3.3.4 Contractor shall document existing facility conditions and systems onsite prior to performing any work with video recording and/or photographs and shall test said systems to identify any pre-existing deficiencies in the presence of the Owner, Architect/Engineer. Any items not noted or identified in this documentation or brought the attention of the Owner in writing will be assumed to be in working order and any problems with such systems will be the responsibility of the Contractor to correct and repair to the pre-contract condition or better.

§ 3.3.5 Prior to performing any work, the Contractor shall locate all utility lines as shown on the plans and specifications, including telephone company lines and cables, sewer lines, water pipes, gas lines, and electrical lines, and shall perform the Work in such a manner as to avoid damaging any such lines, cables, pipes and pipelines. In addition, the Contractor shall independently determine the location of same.

§ 3.4 Labor and Materials

§ 3.4.1 Unless otherwise provided in the Contract Documents, the Contractor shall provide and pay for labor, eligible to work in accordance with state and federal law. In addition, unless otherwise provided in the Contract Documents, the Contractor shall provide and pay for 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.

§ 3.4.2 Except in the case of minor changes in the Work authorized by the Architect in accordance with Sections 3.12.8 or 7.4, the Contractor may make substitutions only with prior written consent of the Owner, after evaluation by the Architect and in accordance with a Change Order, Construction Change Directive, or Change Proposal Request.

§ 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.

§ 3.5 Warranty

(Paragraphs deleted)

§ 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.

The Contractor is solely responsible for, and shall provide written proof of maintenance, service, and protection of materials and equipment installed prior to Substantial Completion.

§ 3.5.2 In the event of failure of materials, products, or workmanship, either during construction or the warranty period (as specified in Section 3.5.5), the Contractor shall take appropriate measures to assure correction or replacement of the defective items, whether notified by the Owner or Architect. Items of work first performed after Substantial Completion shall have their warranties extended by the period of time between Substantial Completion and the actual performance of the Work. Such warranties shall be submitted to owner in writing, documenting such time extensions. This warranty period shall not restrict or modify extended warranties called for or provided on systems, equipment or other specific portions of the work.

§ 3.5.3 Contractor shall establish a spreadsheet-type Warranty Work tracking format included in the Project Manual and shall verify and certify completion of each warranty work item.

§ 3.5.4 Approximately six (6) and eleven (11) months after Substantial Completion, the Contractor shall accompany the Owner and Architect on a complete re-inspection of the Project and be responsible for correcting any additional deficiencies observed or reported, including any uncompleted Punch List Items or outstanding or incomplete Warranty Items.

§ 3.5.5 The Warranty Period for this Project is One (1) Year from the date of Substantial Completion except for any extended warranties as specified herewith in the Contract Documents

§ 3.5.6 The warranty period shall extend one (1) year on specific items of work (materials and labor) if warranty work is performed on a specific item or work that requires the issuance of a second warranty work request within ninety (90) days after the original warranty work request was issued.

§ 3.5.7 Warranty work shall be performed within ten (10) working days after the Contractor receives a request for warranty work, except where immediate responses are required as described below:

- .1 For work which is identified as affecting life safety, fire alarm or security of the occupants and/or the facility on the warranty request, on-site corrective work shall begin immediately after receipt of the warranty work request by the Contractor, 365 days per year, twenty-four (24) hours per day.
- .2 For work affecting the operation of the HVAC system, domestic water heaters, elevators and food service equipment (except walk-in refrigeration and/or freezer equipment), on-site corrective work shall begin within six (6) hours of Contractor's receipt of warranty work, 365 days per year 24 hours per day.
- .3 For walk-in refrigeration and/or freezer equipment, on-site corrective work shall begin within four (4) hours of Contractor's receipt of warranty work, 365 days per year, 24 hours per day.

§ 3.5.8 For warranty work requiring immediate response as described in 3.5.7 above, the Contractor shall maintain or contract for an answering service available 365 days per year, 24 hours per day.

§ 3.5.9 Warranty work shall be completed within six (6) hours after the initiation of on-site corrective work unless additional time is reasonably required, and the Owner has agreed on the additional time frame deemed necessary by the Contractor.

§ 3.5.10 The Owner reserves the right to complete any warranty work that Contractor fails to complete in the specified time period. Owner will backcharge Contractor for the cost of such work, including Consultants' fees.

§ 3.6 Taxes

§ 3.6.1 The Owner is exempt from the Texas Sales Tax on any purchase of tangible personal property and utilities and will issue Certificates of Exemption from the Texas Sales Tax on materials furnished by Contractors on School Construction projects. The Contractor shall give a written statement to the Owner (with a copy to the Architect) as to the proration of costs of skilled crafts, labor and materials for the project prior to awarding of a Construction Contract. The Contractors shall obtain Certificates of Resale from their suppliers in order to avoid payment of the State Sales Tax on materials incorporated in School jobs. Failure of the Contractor to obtain Certificates of Resale from their suppliers shall make the Contractor responsible for absorbing the tax.

§ 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.

§ 3.7.1.1 The Owner will pay directly or to the governing authority directly from the Allowance, the cost of all permanent connection charges, including water and sewer tap charges and the provision and installation of the irrigation meter and the domestic water meter and vault. The Owner will pay directly to the governing authority the cost of all non-taxable entity fees, capacity charges, drainage impact fees and permanent utility account deposits.

§ 3.7.1.2 The Contractor shall pay directly all temporary utility connection charges, including utility district/company inspection, survey, and permit fees for both temporary and permanent connections.

§ 3.7.1.3 The Contractor shall include in the Base Proposal, the cost for providing all backflow preventers, fire sprinkler system backflow preventers, meters, vaults, valves, taps, and piping from taps for domestic water, irrigation, and fire sprinkler systems.

§ 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.

§ 3.7.3 It is neither the Contractor's responsibility nor the Owner's responsibility to ascertain that the Contract Documents are in accordance with applicable laws, statutes, ordinances, codes, rules and regulations. However, if the Contractor observes or should have observed, that portions of the Contract Documents are at variance therewith, the Contractor shall promptly notify the Architect and Owner in writing, and necessary changes shall be accomplished by appropriate modification.

(Paragraphs deleted)

§ 3.7.4 If the Contractor performs Work which he knew or should have known it to be contrary to laws, statutes, ordinances, building codes, and rules and regulations without such notice to the Architect and Owner, the Contractor shall assume appropriate responsibility for such Work and shall bear the costs attributable to correction.

§ 3.8 Allowances

§ 3.8.1 The General Contractor shall include in his proposal all allowances stated in the Specifications.

These stated allowances represent the cost estimate of the materials and equipment delivered and unloaded at the site. The Contractor's supervision, handling costs, estimating costs, miscellaneous fees, overhead, profit, clean-up, as-builts, warranty, and other expenses contemplated for the allowance material and equipment shall be included in allowances only where called for in the various sections of these specifications.

The Contractor shall purchase the allowance materials and equipment as directed by the Architect, upon approval by the Owner, on the basis of the lowest reasonable proposal of at least three (3) competitive proposals unless otherwise directed by Owner. If the actual cost of the materials and equipment delivered and unloaded at the site is more than all the allowance estimates, the Contract Sum will be adjusted by Change Order.

§ 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, miscellaneous fees, overhead, 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 and (2) changes in Contractor's costs under Section 3.8.2.2.

§ 3.8.3 Materials and equipment under an allowance shall be selected by the Owner in sufficient time to avoid delay of the Work.

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§ 3.9 Superintendent

§ 3.9.1 The General Contractor shall employ a competent superintendent and necessary assistants who shall be in attendance at the Project site during performance of the Work including punch list work. The Superintendents and Project Manager shall be satisfactory to the Owner and Architect and shall not be changed except with the consent of the Owner and Architect, unless the Superintendent leaves the employment of the Contractor. No increase in Contract Time or Contract Sum shall be allowed in the event the Owner or Architects objects to any nominated superintendent or project manager. The superintendent and project manager shall represent the Contractor, and communications given to the superintendent and/or project manager shall be as binding as if given to the Contractor.

(Paragraphs deleted)

§ 3.9.2 The Contractor shall furnish to the Owner and the Architect in writing the names and professional qualifications of the persons proposed by the Contractor as the project manager and superintendent with the submitted proposal. The Contractor shall not assign nor substitute any person as the project manager or superintendent to whom the Owner or the Architect has made reasonable objection. No increase in Contract Time or Contract Sum shall be allowed in the event the Owner or Architect objects to any nominated project manager and/or superintendent. The Contractor's submittal of the project manager and superintendent's professional qualifications with his proposal represent the Contractor's acknowledgement that the selection committee's evaluation of the Contractor's proposal includes said superintendent's qualifications and the understanding that said job superintendent will remain on site, full time, until the Architect and Owner have agreed that all punch list work has been completed. See also, Specification Section 01 35 23 – Special Owner Requirements, for additional job superintendent requirements. In addition, the Owner reserves the right to perform a criminal records history review of the proposed superintendent and other Contractor personnel prior to the Contract Award as may be deemed necessary.

§ 3.9.3 Contractor will be required to keep the job superintendents on each job-site during the course of the construction until completion of all punch list items. In the event the job superintendents is absent from any job site at any time during the project contract time or during punch list completion and an agreed upon substitute is not provided, the Owner may backcharge the Contractor \$250.00 per occurrence.

§ 3.9.4 The Contractor shall notify the Owner and Architect at the beginning of the work day if the superintendent is out sick. If the superintendent is to be out for any other reason, the Owner and Architect are to be notified at least 24 hours in advance. In both cases the Owner and Architect are to be informed of the name of the acting superintendent.

§ 3.10 Contractor's Construction Schedules

§ 3.10.1 The Contractor shall, within the time frame specified in Section 01 32 16, prepare and submit for the Owner's and Architect's information a Contractor's construction schedule for the Work. The schedule shall not exceed time limits current under the Contract Documents, shall be revised at appropriate intervals as required by the conditions of the Work and Project, shall be related to the entire Project to the extent required by the Contract Documents, and shall provide for expeditious and practicable execution of the Work.

§ 3.10.2 The Contractor shall prepare a submittal schedule, promptly after being awarded the Contract and thereafter as necessary to maintain a current submittal schedule, and shall submit the schedule(s) for the Architect's approval. The Architect's approval shall not unreasonably be 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, 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.

§ 3.10.4 The Contractor will provide a detailed critical path construction schedule including milestones for this project within the time frame specified in 01 32 16. This schedule shall be prepared using "Suretrak, Primavera, Microsoft Project" or other similar scheduling software. In addition, the Contractor shall submit to the Owner and Architect with each monthly Application for Payment a copy of the progress schedule showing all modifications required to have the schedule reflect appropriate revisions and shall take whatever action is necessary to assure that the project completion schedule is met. The Contractor is required to attend and to give a schedule update at each weekly construction administration meeting and shall provide a detailed 3 week work ahead schedule. The progress schedule will include

percentages of work completed to date along with percentages of work remaining to be completed. These percentages will be used in the verification of the Contractor's monthly Application for Payment. Pay Applications will not be processed by the Owner unless accompanied by an updated progress schedule. If the project is behind schedule, specific input will be required from the Contractor on how he intends to make up the time. If the project remains behind schedule for more than ten (10) working days, for any reason, the Owner, Architect, and Consultants and their associated personnel, shall be compensated by the Contractor, at their standard hourly billing rate, which will be provided as required, until such time as the Contractor can successfully demonstrate to all parties that the project is back on the agreed schedule. Contractor shall provide two (2) large format color prints one (1) for Owner and one (1) for jobsite of the construction schedule monthly with all items showing current status and original baseline schedule.

§ 3.11 Documents and Samples at the Site

The Contractor shall maintain at the site for the Owner one (1) copy of the Drawings, Specifications, Addenda, Change Orders and other Modifications, in good order and marked currently to indicate field changes and selections made during construction, and one (1) copy of approved Shop Drawings, Product Data, Samples and similar required submittals. These shall be available to the Architect and shall be delivered to the Architect for submittal to the Owner upon completion of the Work as a record of the Work as constructed.

§ 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 the way by which 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, (3) checked and coordinated the information contained within such submittals with the requirements of the Work and of the Contract Documents, and (4) coordinated said shop drawings, product data, samples and submittals with adjacent work and its related submittals to be compatible and not in conflict for installation.

§ 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 requirements of the Contract Documents by the Architect's approval of Shop Drawings, Product Data, Samples or similar submittals unless the Contractor has specifically informed the Architect in writing 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, except for any such errors or omissions which are within the Architect's statutory or contractual design responsibility.

§ 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 written 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. 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 cause such services or certifications to be provided by a properly 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, accuracy and completeness of the services, certifications and approvals performed or provided by such design professionals, provided the Owner and Architect have specified to the Contractor all performance and design criteria that such services must satisfy. Pursuant to this Section 3.12.10, the Architect will review, 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. The Contractor shall not be responsible for the adequacy of the performance and design criteria specified in the Contract Documents.

(Paragraphs deleted)

§ 3.12.11 If, in the opinion of the Architect, the Shop Drawings are incomplete, indicate an inadequate understanding of the work covered by the Shop Drawings, or indicate a lack of study and review by the Contractor prior to submittal to the Architect, the Shop Drawings will be returned, unchecked, to the Contractor for correction of any of the above deficiencies and subsequent resubmittal. Additional service charges may be charged to the Contractor by the Architect in this event.

§ 3.12.12 The Contractor shall submit drawings, data and samples to the Architect at least fifteen (15) Regular Work Days prior to the date the Contractor needs the reviewed submittals returned. The Architect and his consultants will be allowed fifteen (15) Regular Work Days for checking from date of submission of shop drawings that are acceptable and do not require re-submission in the opinion of the Architect. Where colors are to be selected by the Architect, submit all product color samples in adequate time to allow the Architect to prepare a complete selection schedule. In general, all submittals requiring color selection shall be submitted to the Architect within eight (8) weeks [four (4) weeks for a summer remodel] of the Contractor's receipt of Notice to Proceed on the Project.

§ 3.12.13 The Contractor shall submit the number of copies of product data and samples which the Contractor and his subcontractors need for their use PLUS two (2) additional sets for the Architect, two (2) additional set for the Owner; one (1) additional set for each of the Architect's consultants involved with the particular Section of Work; (1) additional set of all mechanical shop drawings for TAB and one (1) additional set to be added to each copy of the Owner's Operation and Maintenance manuals at substantial completion. If, in the opinion of the Architect, the Shop Drawings are incomplete; indicate an inadequate understanding of the work covered by the Shop Drawings; or indicate a lack of study and review by the Contractor prior to submittal to the Architect, the Shop Drawings will be returned, unchecked, to the Contractor for correction of these deficiencies and subsequent resubmittal. Additional service charges as outlined in Article 3.2.7 may be charged to the Contractor by the Architect in this event.

§ 3.12.13.1 Where shop drawings are involved, submit one (1) high quality reproducible transparency and one (1) opaque print of the shop drawing for the Architect plus one (1) additional opaque print for each of the Architect's consultants involved with the particular Section of Work and one (1) additional print for each copy of the Owner's Operation and Maintenance Manuals to be submitted at Substantial Completion. The reproducible transparency will be marked by the Architect and/or his consultants and returned to the contractor for his use, distribution, correction or resubmittal, as

required. After final review and correction of the submittal, the Contractor shall send one (1) corrected set to the Architect and one (1) to each of the Architect's consultants involved with the particular Section of Work. Contractor shall also retain one (1) set of all reviewed Mechanical submittals to be transmitted to the HVAC Test and Balance agency selected by Owner.

§ 3.12.14 The Contractor shall deliver in one (1) submittal, all material samples requiring a color selection by the Architect, within eight (8) weeks [four (4) weeks for summer remodel] of the Contractor's receipt of a Notice to Proceed on the Project. The Architect will return material color selections within six (6) weeks [three (3) weeks for summer remodel] of receipt of the color samples from the Contractor.

§ 3.12.15 The Contractor shall produce and submit for review, composite coordination drawings within four (4) weeks of the Contractor's receipt of a Notice to Proceed on the Project. The composite coordination drawings shall depict the coordination of all structural and architectural elements with HVAC piping, ductwork, mechanical equipment, electrical conduit, low voltage systems cabling, lighting, electrical switchgear and panels, security systems, domestic water piping, roof drains and storm sewer piping, sanitary sewer piping and fire sprinkler piping in a composite above ceiling plan and a composite mechanical and electrical equipment room floor plan. Plans shall be produced at a scale of one-quarter (1/4") per foot and shall include larger scale sections with vertical elevations of elements required to confirm coordination of all elements. A schedule value for the production of the composite coordination drawings shall be included in the Continuation Sheet of the Application and Certificate for Payment for each of the Divisions of trade. Refer to specification section 01 31 13 for detail coordination document requirements.

§ 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, and lawful orders of public authorities and the Contract Documents and shall not unreasonably encumber the site with materials or equipment.

§ 3.13.1 Contractor shall ensure that the Work, at all times, is performed in a manner that affords Owner reasonable access, both vehicular and pedestrian, to the site of the work and all adjacent areas. The Work shall be performed in such a manner that public areas adjacent to the site of the Work shall be free from all debris, building material and equipment likely to cause hazardous conditions. Without limitation of any other provision of the Contract Documents, Contractor shall use its best efforts to minimize any interference with the occupancy or beneficial use of any area of the building adjacent to the site of the Work, or the building, in the event of partial occupancy.

§ 3.13.2 Without prior approval of the Owner, the Contractor shall not permit any workers to use any existing facilities at the Project site, including without limitation, lavatories, toilets, entrances, and parking areas, other than those designated by the Owner. The Contractor shall comply with all rules and regulations established by the Owner in connection with the use and occupancy of the Project site and the Building.

§ 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 and patching shall be restored to the condition existing prior to the cutting, fitting and 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 such construction by the Owner or a separate contractor except with written consent of the Owner and of such separate contractor; such consent shall not be unreasonably withheld. The Contractor shall not unreasonably withhold from the Owner or a separate contractor the Contractor's consent to cutting or otherwise altering the Work.

§ 3.15 Cleaning Up

§ 3.15.1 The Contractor shall, on a daily basis, keep the premises and surrounding area free from accumulation of waste materials or rubbish caused by operations under the Contract. 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. See specification section 01 71 50 for specific requirements of final cleaning.

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

(Paragraphs deleted)

§ 3.15.3 Prior to the Architect's inspection for Substantial Completion, the Contractor shall clean exterior and interior surfaces exposed to view; remove temporary labels, stains, and foreign substances; polish transparent and glossy surfaces; clean equipment and fixtures to a sanitary condition; clean roofs; clean site; sweep paved areas and rake clean other surfaces; remove trash and surplus materials from the site.

§ 3.16 Access to Work

The Contractor shall provide the Owner and Architect a job site plan and 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 such 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 the Contractor has reason to believe that the required design, process or product is an infringement of a copyright or a patent, the Contractor shall be responsible for such loss unless such information is promptly furnished to the Architect.

§ 3.18 Indemnification

§ 3.18.1 To the fullest extent permitted by law and to the extent claims, damages, losses or expenses are not covered by Project Management Protective Liability insurance purchased by the Contractor in accordance with Section 11.3, the Contractor shall indemnify and hold harmless the Owner, Architect, Architect's consultants, Third Party consultants, utility service providers involved with the project, 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 which would otherwise exist as to a party or person described in this Section 3.18.

§ 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.

§ 3.19 Substitutions of Materials, Products, or Systems

§ 3.19.1 The materials, products, and the systems 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 equivalent or better materials, products, or systems 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. If prior written approval has not been obtained, it will be assumed that the Proposal is based upon the materials, products, and systems described in the Proposal Documents and no substitutions will be permitted, except as provided hereinafter.

§ 3.19.2 If, prior to submitting his Proposal, a Proposer at any level determines that any of the materials, products, or systems specified will perform in a manner that will limit the Contractor's ability to satisfactorily perform the work or to honor the Warranty, the Proposer shall promptly notify the Architect in writing, providing substantiation for his position. Any necessary changes shall be set forth in an addendum.

§ 3.19.3 The Architect does not bind himself to consider a substitution during the proposal period unless written

request has been submitted to the Architect for approval at least ten (10) days prior to the date for receipt of Proposals. Each such request shall include a "side-by-side" comparison which may include but is not limited to the following; a complete description of the proposed substitute, the name of the material, project, or system for which it is proposed to be substituted, drawings, cuts, performance and test data and any other data or information necessary for a complete evaluation. Incomplete submittals will not be evaluated. If the Architect approves any proposed substitution, such approval will be set forth in an Addendum.

§ 3.19.4 If, after award of contract, the Contractor or one of his Subcontractors or Suppliers determine that any of the products or systems specified will perform in a manner that will limit the Contractor's ability to satisfactorily perform the work or to honor the Warranty, the Contractor shall promptly notify the Architect, in writing, providing detailed substantiation for his position. Any changes deemed necessary by the Owner and Architect, including substitution of materials and change in Contract Sum, either upward or downward, if any, shall be accomplished by appropriate modification.

§ 3.20 Record Drawings

§ 3.20.1 Within seven (7) days after substantial completion of the project, the Contractor shall submit two (2) sets of full-size photocopies of the Job Superintendent's field set of marked plans and specifications.

§ 3.20.2 The Contractor shall provide the Owner with Electronic Record Drawings on a thumb drive or solid-state media drive. Drawings shall mirror the construction document sheets with any additions and changes made during the course of the project. Drawings shall be in both AutoCAD version 18 or later, and PDF or Tiff Format. CAD files shall have all referenced drawings in the same directory or folder. The record drawings shall include electronically all changes made during construction, clouded and keyed to identify the instrument of the change, Change Proposal Request or Change Order. For underground utility piping, revised locations shall also be dimensioned from the column grid lines. The record drawings must be delivered to the Architect at least thirty (30) days prior to receipt of the Contractor's Final Application for Payment. The record drawings shall have a statement added to indicate the purpose of the drawings (i.e. "RECORD DRAWINGS") and shall delete the Architects and/or Engineers seal. See additional requirements in Form 'AO'.

§ 3.20.3 The Contractor is to provide the Owner with Record Specifications (one (1) PDF format on thumb drive or solid-state media drive) which denotes the manufacture of materials incorporated into the Project where more than one acceptable manufacturer is listed, and shall include all changes made during construction, clouded and keyed to identify the instrument of change. The record specifications shall have a statement added to indicate the purpose of the specifications (i.e. "RECORD SPECIFICATIONS"). See additional requirements in Form 'AO'.

§ 3.21 Antitrust Violations

§ 3.21.1 To permit the Owner to recover damages suffered; in antitrust violations, the Owner/Contractor Agreement shall include the following wording, "Contractor hereby assigns to Owner any and all claims for overcharges associated with this contract which are under the antitrust laws of the United States, 15 U.S.C.A., Sec. 1 et.seq. (1973)". The Contractor shall include this provision in his agreements with each subcontractor and supplier. Each subcontractor shall include such provisions in agreements with sub-subcontractors and suppliers

§ 3.22 Prevailing Wage Rates

§ 3.22.1 No employee used in this construction may be paid less than the minimum wage rate provided herein in Article 15.

§ 3.23 Construction Progress Photographs

§ 3.23.1 Contractor shall provide color construction progress photographs during the construction period on a monthly basis to the Architect and Owner. Photographs and digital files on thumb drive or solid-state media drive of photos shall be provided. Construction progress monthly photographs (24 minimum per month, showing all aspects of work accomplished during that month) shall be provided with each and every application for payment.

§ 3.23.2 For New Construction, Building Additions and Miscellaneous Renovations provide (Digital files on thumb drive or solid-state media drive):

Two (2) aerial photographs prior to construction

Two (2) aerial photographs after Final Completion, and

Two (2) aerial photographs of the District facility site each month that there is a change in appearance of the

building exterior and site, or as requested by the Owner.

ARTICLE 4 ADMINISTRATION OF THE CONTRACT

§ 4.1 Architect

§ 4.1.1 The Architect is the person lawfully licensed to practice architecture or an entity lawfully practicing architecture identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The term "Architect" means the Architect or the Architect's authorized representative.

§ 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.

§ 4.1.3 If the employment of the Architect is terminated, the Owner shall employ a new Architect against whom the Contractor has no reasonable objection and whose status under the Contract Documents shall be that of the former Architect.

§ 4.1.4 Except as expressly provided herein, the Contractor shall not be relieved of Contractor's obligation to perform the Work in strict accordance with the Construction Documents and the Contract Documents by the duties, responsibilities, or activities of the Architect.

§ 4.2 Architect's 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 (1) during construction, (2) until final payment is due and (3) with the Owner's concurrence, from time to time during the one-year period for correction of Work described in Section 12.2. The Architect will have authority to act on behalf of the Owner only to the extent provided in the Contract Documents unless otherwise modified in writing in accordance with other provisions of the Contract.

§ 4.2.2 The Architect shall visit the site at least twice per week (or more per week when deemed necessary by the Owner's Superintendent or Designee or when necessary to protect Owner's interests) and at any other intervals appropriate to the stage of construction, to inspect the progress, quantity and quality of the Work completed, to reject any observed nonconforming Work, and to determine if the Work is being performed in a manner indicating that the Work, when completed, will be in accordance with the Construction Documents and the Contract Documents and on time. Furthermore, a minimum of two job site meetings per month from commencement of construction through Final Completion will be initiated by the Architect and attended by the Contractor. Attendees will include Owner, the Contractor's project manager and/or superintendent, Architect's project representative, and Architect. The Architect, Owner and their representatives shall at all times have access to the Work. Architect, or its structural consultant will provide on-site observation prior to and during all concrete pours that contribute to the structural integrity of the building, including all pours of concrete piers, footings, grade beams, floor slabs, and concrete superstructure components, if applicable. In addition, Architect or its structural consultant will provide on-site observation prior to covering up or closing up of portions of the construction, which if covered, would conceal problems with the structural integrity of the Project. Contractor shall not close or cover said Work until said observations have occurred. Contractor or Architect will advise Owner of the need for any third-party laboratory or testing services to assist the Architect and Owner. On the basis of the on-site observations by Architect, Architect shall keep Owner and Contractor informed of the progress and the quality of the Work, through Architect's field reports, and shall guard Owner against defects and deficiencies in the Work. Architect shall promptly notify Owner and Contractor, orally, regarding any defect or nonconforming Work, which shall be followed by notice in writing of defects or nonconforming Work noted and corrective action taken or recommended. The Architect, however, shall not have control over, or responsibility for the Contractor's construction means, methods, techniques, sequences, procedures, or safety programs, but this does not relieve Architect of Architect's responsibilities under this Agreement. Any services by Contractor made necessary by Contractor's construction defect or nonconforming Work, shall be performed at no additional cost to Owner.

§ 4.2.3 The Architect will keep the Owner reasonably informed about the progress and quality of the portion of the Work completed, and report to the Owner (1) known deviations from the Contract Documents and from the most recent construction schedule submitted by the Contractor, and (2) defects and deficiencies observed in the Work. 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. The Architect shall endeavor to guard the Owner against defects and deficiencies in the Work.

§ 4.2.4 Communications Facilitating Contract Administration

Except as otherwise provided in the Contract Documents or when direct communications have been specially authorized, the Owner and Contractor shall endeavor to communicate with each other through the Architect about matters arising out of or relating to the Contract. Communications by and with the Architect's consultants shall be through the Architect. Communications by and with Subcontractors and material suppliers shall be through the Contractor. Communications by and with separate contractors shall be through the Owner.

§ 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 has authority to reject Work that does not conform to the Contract Documents. Whenever the Architect considers it necessary or advisable, the Architect will have authority to require additional inspection or testing of the Work in accordance with Sections 13.5.2 and 13.5.3, whether or not such Work is fabricated, installed or completed. However, neither this authority of the Architect 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 to the Contractor, Subcontractors, material and equipment suppliers, their agents or employees, or other persons or entities performing portions of the Work.

§ 4.2.7 The Architect will review, 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 as to cause no delay in the work or in the activities of the Owner, Contractor, or Subcontractor, 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, unless otherwise specifically stated by the Architect, 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.

§ 4.2.8 The Architect will prepare Change Orders, Change Proposal Requests, and Construction Change Directives, and may authorize minor changes in the Work as provided in Section 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; will 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, and will issue a final Certificate for Payment upon compliance with the requirements of the Contract Documents.

§ 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.

§ 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. The Architect's response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness. If no agreement is made concerning the time within which interpretations required of the Architect shall be furnished in compliance with this Section 4.2, then delay shall not be recognized on account of failure by the Architect to furnish such interpretations until 15 days after written request is made for them.

§ 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.

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§ 4.2.13 The Architect's decisions on matters relating to aesthetic effect will be final if consistent with the intent expressed in the Contract Documents.

§ 4.2.14 The Contractor shall not cover up any work without the Architect and Owner performing an observation of such work. The Contractor will be responsible for any and all associated costs to allow for observations of the work, uncovered, by the Architect and Owner if the Contractor covers work without either the consent of the Architect and Owner or without providing the Architect and Owner with reasonable opportunity to observe the work, whether or not such work is found to be acceptable by the Architect or Owner.

§ 4.3 Claims and Disputes

§ 4.3.1 Definition. A Claim is a demand or assertion by one of the parties seeking, as a matter of right, adjustment or interpretation of Contract terms, payment of money, extension of 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, Architect and Contractor arising out of or relating to the Contract. Claims must be initiated by written notice. The responsibility to substantiate Claims shall rest with the party making the Claim.

§ 4.3.2 Time Limits on Claims. Claims by either party 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. Claims must be initiated by written notice to the Architect and the other party.

§ 4.3.3 Continuing Contract Performance. Pending final resolution of a Claim unless as otherwise agreed in writing, the Contractor shall proceed diligently with performance of the Contract.

§ 4.3.4 Claims for Concealed or Unknown Conditions. If conditions are encountered at the site which are (1) subsurface or otherwise concealed physical conditions which differ materially from those indicated in the Contract Documents or (2) unknown physical conditions of an unusual nature, which 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, then notice by the observing party shall be given to the other party promptly before conditions are disturbed and in no event later than 21 days after first observance of the conditions. The Architect will promptly investigate such conditions and, if 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 an equitable adjustment 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 so notify the Owner and Contractor in writing, stating the reasons. Claims by either party in opposition to such determination must be made within twenty-one (21) days after the Architect has given notice of the decision. If the conditions encountered are materially different, the Contract Sum and Contract Time shall be equitably adjusted, but if the Owner and Contractor cannot agree on an adjustment in the Contract Sum or Contract Time, the adjustment shall be referred to the Architect for initial determination, subject to further proceedings pursuant to Section 4.4.

§ 4.3.5 Claims for Additional Cost. If the Contractor wishes to make Claim for an increase in the Contract Sum, written notice as provided herein shall be given before proceeding to execute the Work. Prior notice is not required for Claims relating to an emergency endangering life or property arising under Section 10.6.

§ 4.3.6 If the Contractor believes additional cost is involved for reasons including but not limited to (1) a written interpretation from the Architect, (2) an order by the Owner to stop the Work where the Contractor was not at fault, (3) a written order for a minor change in the Work issued by the Architect, (4) failure of payment by the Owner, (5) termination of the Contract by the Owner, (6) Owner's suspension or (7) other reasonable grounds, Claim shall be filed in accordance with this Section 4.3.

§ 4.3.7 Claims For Additional Time

§ 4.3.7.1 If the Contractor wishes to make Claim for an increase in the Contract Time, written notice as provided herein 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.

§ 4.3.7.2 If adverse weather conditions are the basis for a Claim for additional time, such Claim shall be documented by data substantiating that weather conditions were abnormal for the period of time, could not have been reasonably anticipated and had an adverse effect on the scheduled construction.

§ 4.3.8 Injury or Damage to Person or Property. If either party to the Contract 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, written notice of such 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.

§ 4.3.9 If unit prices are stated in the Contract Documents or subsequently agreed upon, and if quantities originally contemplated are materially changed in a proposed Change Order or Construction Change Directive so that application of such unit prices to quantities of Work proposed will cause substantial inequity to the Owner or Contractor, the applicable unit prices shall be equitably adjusted.

§ 4.3.10 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 without limitation:

- .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 4.3.10 shall be deemed to preclude an award of liquidated direct damages, when applicable, in accordance with the requirements of the Contract Documents.

§ 4.4 Resolution of Claims and Disputes

§ 4.4.1 Decision of Architect. Claims, including those alleging an error or omission by the Architect, shall be referred initially to the Architect for recommendation. If the parties are unable to agree, an appeal may be submitted as stated in Section 4.4.1.1 below.

§ 4.4.1.1 Any claim, disputes or matters arising out of this contract between the Architect, Owner and Contractor or any combination of those parties shall be submitted to a court of appropriate jurisdiction.

§ 4.4.2 The Architect will review Claims and within ten (10) days of the receipt of the Claim take one or more of the following preliminary actions: within ten (10) days of receipt of claim: (1) request additional supporting data from the claimant, (2) submit a schedule to the parties indicating when the Architect expects to take action, (3) reject the Claim in whole or in part, stating the reasons for rejection, (4) recommend approval of the Claim by the other party, or (5) suggest a compromise.

§ 4.4.3 In evaluating Claims, the Architect 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 Architect in rendering a decision. The Architect may request the Owner to authorize retention of such persons at the Owner's expense.

§ 4.4.4 If the Architect requests a party to provide a response to a Claim or to furnish additional supporting data, such party shall respond, within ten (10) days after receipt of such request, and shall either provide a response on the requested supporting data, advise the Architect when the response or supporting data will be furnished or advise the Architect that no supporting data will be furnished. Upon receipt of the response or supporting data, if any, the Architect will either reject or approve the Claim in whole or in part.

§ 4.4.5 The Architect will approve or reject Claims by written decision, which shall state the reasons therefore and which shall notify the parties of any change in the Contract Sum or Contract Time or both. The approval or rejection of a Claim by the Architect shall be final and binding on the parties but subject to mediation.

§ 4.4.6 Upon receipt of a Claim against the Contractor or at any time thereafter, the Architect or 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 Architect or the Owner may, but is not obligated to, notify the surety and request the surety's assistance in resolving the controversy.

§ 4.4.7 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 prior to resolution of the Claim by the Architect, or by mediation.

§ 4.4.8 If a Claim has not been resolved after consideration of the foregoing and of further evidence presented by the parties or requested by the Architect, the Architect will notify the parties in writing that the Architect's decision will be made within seven (7) days.

Upon expiration of such time period, the Architect will render to the parties the Architect's written decision relative to the Claim, including any change in the Contract Sum or Contract Time or both. If there is a surety and there appears to be possibility of a Contractor's default, the Architect shall notify the surety and request the surety's assistance in resolving the Claim.

§ 4.5 Mediation

§ 4.5.1 Any Claim arising out of or related to the Contract, except Claims relating to aesthetic effect and except those waived as provided for in Sections 4.3.10, 9.10.4 and 9.10.5 shall, after initial decision by the Architect or 30 days after submission of the Claim to the Architect, be subject to mediation only upon the mutual consent of both parties. In the event that mutual consent is not achieved, the parties are free to pursue any claims, disputes or matters in any manner allowed by law.

§ 4.5.2 Mediation, unless the parties mutually agree otherwise, shall be in accordance with the Construction Industry Mediation Rules of the American Arbitration Association currently in effect. Request for mediation shall be filed in writing with the other party to the Contract and with the American Arbitration Association.

§ 4.5.3 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.

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

(Paragraph deleted)

§ 5.2.1 As soon as practicable after award of the Contract, but not later than five (5) days prior to the submittal date for the Contractor's first Application for Payment, the Contractor shall furnish in writing to the Owner and the Architect the names of persons or entities (including those who are to furnish materials or equipment fabricated to a special design) proposed for each principal portion of the Work. Where subcontractors have been listed in the Specifications or on the Contractor's Proposal Form, the proposed entities shall be those firms listed in the Specifications and on the Contractor's Proposal Form, unless an agreement has been reached with the Owner to accept a proposed substitute(s). The Architect will promptly reply to the Contractor in writing stating whether or not the Owner or the Architect, after due investigation, has reasonable objection to any such proposed person or entity. Failure of the Owner or Architect to reply promptly shall constitute notice of no objection. Failure of the Contractor to submit the subject names in a timely manner will delay processing of the Contractor's Application for Payment.

§ 5.2.2 The Contractor shall not contract with a proposed person or entity to whom the Owner or Architect has made a timely objection. The Contractor shall not be required to contract with anyone to whom the Contractor has made an objection under provisions of Subparagraph 5.2.1.

§ 5.2.3 If the Contractor has acted promptly and responsibly in submitting names as required, and the Owner or Architect objects to a person or entity proposed by the Contractor, the Contractor shall propose another to whom the Owner or Architect has no objection. The Contract Sum shall be increased or decreased by the difference, if any, occasioned by such change, and an appropriate Change Order shall be issued before commencement of the substitute Subcontractor's Work.

§ 5.2.4 Prior to any substitution of a subcontractor by the Contractor, the Contractor shall notify the Architect of his intent and reasons for such proposed substitutions. The Contractor shall not substitute a Subcontractor, person or entity previously selected if the Owner or Architect objects to such change.

(Paragraphs deleted)

§ 5.2.5 The Contractor shall submit the list of proposed Subcontractors on AIA Document G805 or the form provided in the Project Manual.

§ 5.2.6 The Contractor is required to visit the site and completely familiarize himself with the existing conditions prior to the proposal. Neither additional increase in the Contract Sum nor extension in Contract Time will be granted when existing or known conditions require a certain amount of work to comply with the intent of the Contract Documents.

§ 5.3 Subcontractual Relations

By appropriate agreement, written where legally required for validity, 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, which the Contractor, by these 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. 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. Each subcontractor shall provide proof of insurance to Contractor consistent with the Contractor's insurance to Owner and in an amount commensurate with the Work to be performed by the 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 in writing; and
- .2 assignment is subject to the prior rights of the surety, if any, obligated under bond relating to the Contract.

§ 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.

(Paragraph deleted)

§ 5.5 Neither the Owner nor the Architect shall be obligated to pay or to ensure the payment of any monies to subcontractors due to any non-payment to the Contractor or non-payment of subcontractors by the Contractor.

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 Owner reserves the right to perform construction or operations related to the Project with the Owner's own forces, and to award separate contracts in connection with other portions of the Project or other construction or operations on the site under Conditions of the Contract identical or substantially similar to these including those portions related to insurance and waiver of subrogation. If the Contractor claims that delay or additional cost is involved because of such action by the Owner, the Contractor shall make such Claim as provided in Section 4.3.

§ 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 other separate contractors and the Owner in reviewing their construction schedules when directed to do so. The Contractor shall make any revisions to the construction schedule deemed necessary after a joint review and mutual agreement. The construction schedules 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, the Owner shall be deemed to be subject to the same obligations and to have the same rights that apply to the Contractor 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 report to the Architect apparent discrepancies or defects in such other construction that would render it unsuitable for such proper execution and results. Failure of the Contractor so to report 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, except as to defects not then reasonably discoverable.

§ 6.2.3 The Owner shall be reimbursed by the Contractor for costs incurred by the Owner which are payable to a separate contractor because of delays, improperly timed activities or defective construction of the Contractor. The Owner shall be responsible to the Contractor for costs the Contractor incurs because of delays, improperly timed activities, damage to the Work or defective construction of a separate contractor.

§ 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, Change Proposal Request, Construction Change Directive, order for a minor change in the

Work, or a Change Proposal Request issued by Architect or Contractor, signed by Owner, subject to the limitations stated in this Article 7 and elsewhere in the Contract Documents.

§ 7.1.2 All Change Orders and Change Proposal Requests 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, and the Contractor shall proceed promptly, unless otherwise provided in the Change Order, Change Proposal Request Construction Change Directive or order for a minor change in the 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 stating their agreement upon all of the following:

- .1 The change in the Work;
- .2 The amount of the adjustment, if any, in the Contract Sum; and
- .3 The extent of the adjustment, if any, in the Contract Time.

§ 7.2.2 The parties mutually may agree upon a Change Order that adjusts Contract Time and/or Contract Sum based on a change in the Scope of Work requested by the Owner or that results from unanticipated, extraordinary adverse weather conditions as described in Article 15 of these General Conditions. The parties further agree that Contractor shall proceed with the Work only as set forth in a Change Order upon Contractor's physical receipt of a Change Order duly executed by the Owner. Contractor shall be entitled to reimbursement of a previously agreed to cost for estimating services.

§ 7.2.3 If a change in the Work is to be ordered, a written request shall be issued by Owner to Contractor describing the change and requesting the submission of a Change Order Request. When time does not permit the processing of a Change Order in advance of commencing the change in the Work, upon receipt of a written authorization from Owner, Contractor shall proceed with a change in the Work pursuant to a Construction Change Directive and Contractor shall concurrently proceed with submission of a Change Order Request.

§ 7.2.4 Within thirty (30) days following receipt of a written request, Contractor shall submit a Change Order Request to Owner together with the revised or new documents which, if approved, will become part of the Contract Documents setting forth any requested adjustment in the Contract Sum or the Contract Time, and including an itemization of all costs of material and labor with extensions listing quantities and total costs, and a substantiation of any Claim for an extension of the Contract Time. Any Change Order for a change in the work must be signed by the Owner before the Owner is obligated for payment related to the Change Order. If Contractor is unable to submit the above information within the time limit, it shall notify Owner in writing, setting forth for Owner's approval a date by which Contractor will submit the information as well as a schedule for the performance of the Work for which a Change Order Request will be forthcoming. If within the 30 days the Construction Manager cannot ascertain the financial or time impact of a claim a letter alerting the Owner of a forthcoming claim will suffice. This must be sent during this 30-day window.

§ 7.2.5 If Owner accepts a Change Order Request submitted by Contractor, Contractor shall prepare a Change Order that is based upon such Change Order Request for execution by Contractor and Owner and to the extent that the Owner and Contractor agree, the Contract Sum and Contract Time shall be adjusted as provided in the Change Order upon execution of such Change Order.

§ 7.2.6 Nothing contained herein shall limit the right of Owner to order changes in Work by Change Orders that have not been signed by Contractor, and Contractor shall promptly perform all Work required under the Contract Documents or a Change Order despite its failure to execute the Change Order. However, the Owner shall issue and execute a Change Order authorizing payment for all undisputed amounts.

§ 7.2.7 No change in the Work shall be the basis of an addition to the Contract Sum or a change in the Contract Time unless and until such change has been authorized by a Change Order executed and issued by the Owner in accordance with the Contract Documents. Changes in the Work may be made without notice to Contractor's sureties and absence of such notice shall not relieve such sureties of any of their obligations to Owner.

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§ 7.2.8 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 or delay damages, arising from the subject matter of the Change Order; or attorneys' fees and costs arising from a dispute with a Subcontractor over the Change Order.

§ 7.2.9 Methods used in determining adjustments to the Contract Sum shall be those listed in Section 7.3.3.

§ 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 and/or Change Proposal Request shall be used in the absence of total agreement on the terms of a Change Order.

§ 7.3.3 The cost or credit to the Owner resulting from a change in the Work shall be determined in one or more ways listed below. The first method listed shall be used unless the Architect determines that the method is inappropriate, in which case another method shall be selected:

- .1 By mutual acceptance of a lump sum properly itemized and supported by sufficient substantiating data to permit evaluation. Contractor shall provide on company letterhead backup documentation and submit proposal cost and/or by either using unit costs method with attached supporting data or by using labor, materials and equipment method with attached supporting data. One form shall be utilized by each trade involved in the change in the work with an overall summary form by the Contractor for the entire change. Where additional Work is involved, the lump sum shall represent the estimated cost of labor and materials; plus markups to cover miscellaneous fees and profit if not funded by an allowance:

To compensate the Contractor or Subcontractor actually performing a part of the Work for the combined cost of miscellaneous fees and profit, the performing party shall be entitled to a single markup not to exceed 15% of the estimated cost of that part of the Work.

To compensate the Contractor for the combined cost of miscellaneous fees and profit on work performed by Subcontractors, the Contractor shall be entitled to a single markup not to exceed 10% of the subcontract amount if not funded from an allowance. (Contractor shall not be allowed a markup for miscellaneous fees and profit if change is funded by an allowance.)

When a Sub-subcontractor performs the Work of a change, the 15% markup for combined miscellaneous fees and profit shall be used only by the Subcontractor. The Subcontractor and Contractor would each be entitled to a single markup not to exceed 10% of the cost to them from the Subcontractor and sub-subcontractor respectively if not funded by an allowance. (Contractor shall not be allowed a markup for miscellaneous fees and profit if change is funded by an allowance.)

- .2 By unit prices stated in the Contract Documents or subsequently agreed upon; Additional markups for miscellaneous fees, and profit will not be allowed in Unit Price Work;
- .3 By 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 Subsection 7.3.6.
- .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 labor, materials, and Subcontracts. Labor and materials shall be itemized in the manner prescribed above on company letterhead. Where major cost items are Subcontracts, they shall be itemized also. In no case will a change be approved without such itemization.
- .6 For changes in the work the Contractor, Owner and Architect agree to be bound by the below stated required time lines.

Upon issuance of a Change document, Contractors, Subcontractors and Sub-subcontractors shall provide the proposed pricing on company letterhead with the required supporting back up

documentation no later than fifteen (15) business days after receipt of the proposed change document. Architect and Owner shall review Contractor's pricing and within ten (10) business days accept pricing as submitted by the Contractor or reject the pricing and return to the Contractor with specific reasons for rejections. If pricing is rejected, Contractor shall review the specific rejections and modify pricing to address the specific rejection and resubmit to the Architect and Owner comments within two (2) business days after receipt of rejection comments. The Architect and Owner shall review the revised pricing and either accept the revised pricing, or if pricing is still in dispute, the Architect shall issue a Construction Change Directive.

§ 7.3.4

(Paragraphs deleted)

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.

§ 7.3.5 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.

§ 7.3.6 If the Contractor does not respond promptly or disagrees with the method for adjustment in the Contract Sum, the Architect or Owner shall determine the method and 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 miscellaneous fees, overhead and profit except if funded by Allowance. In such case, and also under Section 7.3.3.3, the Contractor shall keep and present, in such form as the Architect may prescribe, an itemized accounting together with appropriate supporting data. Unless otherwise provided in the Contract Documents, costs for the purposes of this Section 7.3.7 shall be limited to the following:

- .1 costs of labor, including social security, retirement and unemployment insurance, fringe benefits required by agreement or custom, and workers' compensation insurance;
- .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, and;
- .4 additional costs of supervision and field office personnel directly attributable to the change.

§ 7.3.7 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. When both additions and credits covering related Work or substitutions are involved in a change, the allowance for miscellaneous fees and profit shall be figured on the basis of net increase or decrease, if any, with respect to that change.

§ 7.3.8 Pending final determination of the total cost of a Construction Change Directive to the Owner, amounts not in dispute for such changes in the Work shall be included in Applications for Payment accompanied by an approved Change Order or Change Proposal Request indicating the parties' agreement with part or all of such costs. For any portion of such costs that remains in dispute, the Architect will make an interim determination for purposes of monthly certification for payment for those costs. The 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 4.

§ 7.3.9 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 shall be recorded by preparation and execution of an appropriate Change Order.

(Paragraph deleted)

§ 7.4 Minor Changes in the Work

§ 7.4.1 The Architect has authority to order minor changes in the Work not involving adjustment in the Contract Sum or extension of the Contract Time and not inconsistent with the intent of the Contract Documents with Owner's written approval. Such changes will be effected by written order and shall be binding on the Owner and Contractor. The Contractor shall carry out such written orders promptly with Owner's written approval.

§ 7.5 Changes Funded by Allowances

§ 7.5.1 Allowance balances may be used to fund changes in the work. The Contractor will not be allowed a mark-up for overhead and profit when changes in the work are funded by one of the Allowances. Cost for changes funded by allowances shall be determined by methods described in Article 7.3.3. Miscellaneous fees and profit mark-up shall be allowed on work performed by Subcontractors, Sub-subcontractors and the Contractor's own forces, in accordance with Section 7.2 and 7.3.

§ 7.5.2 Changes funded by Allowances shall require back-up documentation per Section 7.3.3.

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 Unless agreed otherwise, the date inserted on the Agreement form and the Date of Commencement constitute "0" (zero) of the stated Completion Time.

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

§ 8.1.4 The term "day" as used in the Contract Documents shall mean calendar day unless otherwise specifically defined. The term "regular working day" as used in the Contract Documents shall mean any day from Monday through Friday, exclusive of those holidays normally recognized in the construction industry and/or approved by District-approved calendar.

§ 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, prematurely commence operations on the site or elsewhere prior to the effective date of insurance required by Article 11 to be furnished by the Contractor and Owner, and approved by the Owner. The date of commencement of the Work shall not be changed by the effective date of such insurance. Unless the date of commencement is established by the Contract Documents or a notice to proceed given by the Owner, the Contractor shall notify the Owner in writing not less than five (5) days or other agreed period before commencing the Work to permit the timely filing of mortgages, mechanic's liens and other security interests.

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

§ 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 an act or neglect of the Owner or Architect, or of an employee of either, or of a separate contractor employed by the Owner; or by changes ordered in the Work; or by fire, or other causes beyond the Contractor's control; or by delay authorized by the Owner pending mediation and arbitration; or by other causes that the Architect and Owner determines may justify delay, then the Contract Time shall be extended by Change Order for such reasonable time as the Architect and Owner may determine.

§ 8.3.2 Claims relating to time shall be made in accordance with applicable provisions of Article 4.

§ 8.3.3 This Section 8.3 does not preclude recovery of damages for delay by either party under other provisions of the Contract Documents.

§ 8.3.4 Extensions of time granted for causes described herein will be granted on the basis of one Regular Working Day extension for each Regular Working Day lost (i.e. seven (7) Calendar Days extension will be granted after five (5) Regular Work Days are lost except as modified by the provisions contained herein related to Anticipated Weather days).

§ 8.3.5 Each Proposer shall include in his proposed construction schedule an allowance of regular work days per year as defined in 1.7.7.4, in which work is delayed for student testing or other unspecified campus events. In addition, each proposer shall include an allowance of Anticipated Weather Days in accordance with following:

Number of anticipated Weather Days (These are regular working days)

| | | | |
|----------|---|-----------|---|
| January | 5 | July | 8 |
| February | 5 | August | 8 |
| March | 5 | September | 7 |
| April | 4 | October | 4 |
| May | 7 | November | 6 |
| June | 7 | December | 5 |

§ 8.3.6 Weather Days shall pertain to such items as rain, flooding, snow, unusually high winds, excessively wet grounds, or the like which prevent progress on major portions of the work on regular working days only. If such situations occur on more than the number of Anticipated Weather Days indicated above and if those additional days prevent the Contractor from performing critical portions of the scheduled work, extensions of time cause by inclement weather may be requested as enumerated hereinafter: if the inclement weather is rain related, the rain at the site must have been in excess of 0.5 inch in 24 hours.

§ 8.3.7 At the beginning of each month the Contractor shall submit a status report for the preceding month, showing 1) the scheduled number of Anticipated Weather Days for the particular month, 2) the actual Weather Days requested, and 3) the Net Weather Days (plus, minus, or no change). At times deemed appropriate by the Architect or when requested in writing by the Contractor, the Contract time will be adjusted by Change Order if the total of Net Weather Days is substantially greater than "0". Unused Anticipated Weather Days may be accumulated during the Contract Time and may be used to offset Actual Weather days in other months. If the Contractor fails to submit said monthly status report, it will be assumed that none of the Anticipated Weather Days were used for that month and that they shall accumulate for possible future offset against Net Weather Days; however, if at the end of the project all Anticipated Weather days have not been used, the contract completion time will not be reduced. An example of the monthly schedule to be submitted is as follows:

| Month | Anticipated Weather Days (Regular) | Actual Weather Days (Regular) Requested | Net Weather Days (Regular) |
|---------------|------------------------------------|---|----------------------------|
| January | 5 | 11 | 6 |
| February | 5 | 0 | -5 |
| March | 5 | 2 | -3 |
| April | 4 | 2 | -2 |
| May | 7 | 12 | 5 |
| June | 7 | 11 | 4 |
| Totals | 33 | 38 | 5 |

Using this example (and assuming that all requested days were approved) there were 5 Net Weather Days (regular) for the six (6) months of the project and the extension of Contract Time would be seven (7) Calendar Days).

§ 8.3.8 Extensions of the Contract Time will only be considered after the number of anticipated delay days has been expended through mutual agreement by the Owner, Architect and Contractor.

§ 8.3.9 The following is a requirement of the Contract and will be included in the Agreement Between Owner and Contractor under Time of Completion and the blank spaces will be completed indicating the completion date as stated on the Proposal Form.

§ 8.3.10 The Work to be performed under this Contract shall be commenced in accordance with Section 8.1.2 and the following Substantial Completion Date(s) must be achieved. Refer to the Project Manual for description of Phasing, if any.

1. Refer to Document A101-2017 Standard Form of Agreement Between Owner and Contractor as amended, Article 3.3 for required substantial completion date(s).

The parties hereto agree that time is of the essence of this Contract and that the pecuniary damages which would be suffered by the Owner, if the Contractor does not achieve the phased construction completion called for in the Contract Documents by the specified dates, are in their very nature difficult to ascertain. Refer to Section 8.4 for Liquidated Damages.

§ 8.4 Liquidated Damages

§ 8.4.1 The parties hereto agree that time is of the essence of this Contract and that the pecuniary damages which would be suffered by the Owner, if the Contractor does not achieve the phased construction completion called for in the Contract Documents by the specified dates, are in their very nature difficult of ascertainment. The sums per Calendar Day to be paid in consideration of all actual costs such as rental costs, additional supplies, labor, overtime, and especially disruption of the educational programs and lost administrative time, which cannot be readily determined are as follows:

| | |
|---|-------------------------|
| Elementary Schools (New Construction and/or Renovations): | \$1,000.00/Calendar Day |
| Middle Schools (New Construction and/or Renovations): | \$2,000.00/Calendar Day |
| High Schools (New Construction and/or Renovations): | \$3,000.00/Calendar Day |
| Athletic Fields (New Construction and/or Renovations): | \$1,000.00/Calendar Day |
| Miscellaneous Facilities (New Construction and/or Renovations): | \$1,000.00/Calendar Day |

§ 8.4.1.1 It is therefore expressly agreed as a part of the consideration inducing the Owner to execute this Contract that the Owner may deduct from the Final Payment made to the Contractor an equitable sum per Calendar Day for each and every Calendar Day beyond the specified date of Substantial Completion, which the Contractor shall require for Substantial Completion of the Work included in this Contract. It is expressly understood that 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 legally 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 additional compensation to personnel, for loss of interest on money, and other increased costs, all of which are by their nature difficult of exact ascertainment.

§ 8.4.1.2 If the Contractor fails to complete all requirements of Final Completion within ninety (90) days after the actual Substantial Completion date, Contractor shall be required to attend weekly meetings at the job site or Owner's office until such time as the close-out documents and all punch list items are completed and accepted by Owner. During this time the General Contractor will be charged for the Owner's, Architect's, and any consultant's time. Billable time will include without limitation travel time, meeting time, document preparation, document review, and re-inspection of on-site conditions. These weekly meetings shall include a minimum two (2) hour charge per participant. Costs will be deducted from Contractor's Final Payment. Hourly rates shall be as follows:

Consultants:

- Principal Architect/Engineer/Consultant: \$175.00
- Project Architect/Engineer/Consultant \$150.00
- Staff Architect/Engineer/Consultant \$120.00
- Field Representative/Architect/Engineer/Consultant \$100.00
- Secretarial \$ 50.00

Project Owner:

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- Associate Superintendent \$225.00
- Assistant Superintendent \$200.00
- Director \$175.00
- Senior Project Manager \$165.00
- Project Manager \$150.00
- Project Coordinator \$120.00
- Secretarial \$ 50.00
- Maintenance Technician \$ 50.00
- Operations Personnel \$ 33.00

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.

(Paragraph deleted)

§ 9.2 Schedule of Values

§ 9.2.1 Before the first Application for Payment, the Contractor shall submit to the Architect a schedule of values allocated to various portions of the Work, prepared in such form and supported by such data to substantiate its accuracy as the Architect and Owner may require. This schedule, unless objected to by the Architect or Owner, shall be used as a basis for reviewing the Contractor’s Applications for Payment.

§ 9.2.2 In order to facilitate the review of Applications for Payment, the Schedule of Values shall be submitted on AIA Documents G702 and G703 or other similar forms approved by the Owner, and shall include the following:

- .1 General Contractor’s costs for Contractor’s fee, bonds and insurance, mobilization, project close-out etc., shall be listed as individual line items.
- .2 Contractor’s costs for various construction items shall be detailed. For example, concrete Work shall be subdivided into footings, grade beams, floor slabs, paving, etc. These subdivisions shall appear as individual line items.
- .3 On major subcontracts, such as mechanical, electrical, plumbing, and low voltage, the schedule shall indicate line items and amounts in detail (e.g. underground, major equipment, fixtures, installation of fixtures, start up, close-out, etc.)
- .4 Costs for subcontract Work shall be listed without any addition of General Contractor’s costs for miscellaneous fees, profit or supervision.
- .5 Where payment for stored materials may be requested prior to installation, material and labor shall be listed as separate line items. Stored materials will only be paid for the amount of actual invoices of same materials.
- .6 Sample pages from an approved schedule of values are included in Section 01 29 73 of the project specifications.
- .7 Where work occurs at more than one building, for the Owner’s accounting purposes and to facilitate the checking and verification of the Contractor’s Application for Payment, cost shall be scheduled separately for each building on the G703 Continuation Sheets. Building additions and renovations shall be listed separately.
- .8 All work outside the building envelope excluding overhangs and canopies shall be listed separately under Site work.

§ 9.3 Applications for Payment

§ 9.3.1 At least ten (10) days before the date established for each progress payment, the Contractor shall submit to the Architect an itemized Application for Payment for operations completed in accordance with the schedule of values.

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Prior to this submittal, the Contractor shall contact the Architect's Field Department and Owner for on-site review of the proposed application. On-site reviews shall include review of all lien releases and stored materials. See project manual for additional requirements. Upon approval by the Architect's Field Department and Owner, the Application for Payment shall be notarized and submitted to the Architect. Included shall be data required to support lien releases, Application for Payment Checklist (Section CA), invoices and/or receipts. Such application shall be notarized, if required, and supported by such data substantiating the Contractor's right to payment as the Owner or Architect may require, such as copies of requisitions from Subcontractors and material suppliers, and reflecting retainage if provided for in the Contract Documents.

§ 9.3.1.1 As provided in Section 7.3.8, such applications may include requests for payment on account of changes in the Work that have been properly authorized by Change Proposal Requests, but not yet included in Change Orders.

(Paragraph deleted)

§ 9.3.2 Payments will be made on account of materials or equipment 1) incorporated in the Work and 2) Suitably stored at the site or 3) suitably stored at some off-site location provided the following conditions are met for off-site storage:

- .1 The location must be agreed to, in writing, by the Owner and Surety.
- .2 The location must be a bonded warehouse.
- .3 Surety must agree, in writing, to each request for payment.
- .4 The Contractor must bear the cost of the Owner's and Architect's expenses related to visiting the off-site storage area.
- .5 All items shall be marked and clearly tagged as property of the Owner.

Payments for materials or equipment stored on or off the site shall be conditioned upon submission by the Contractor of bills of sale or such other procedures satisfactory to the Owner to establish the Owner's title to such materials or equipment or otherwise protect the Owner's interest, including applicable insurance (naming the Owner as insured) and transportation to the site for those materials and equipment. Under no circumstances will the Owner reimburse the Contractor for down payments, deposits, or other advance payments for materials or equipment. Contractor shall only be paid for the amount of the actual invoices submitted as backup for stored materials.

The Contractor acknowledges that the review of materials stored off site is an additional service of the Architect and shall be charged for that service. The cost for that service will be established by the Architect and is not subject to appeal.

§ 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, material suppliers, or other persons or entities making a claim by reason of having provided labor, materials and equipment relating to the Work.

§ 9.3.4 Contractor's progress payment draws for fees and general conditions (including miscellaneous fees and profit) shall not exceed the percentage completion of the Work in place for the entire Project as indicated on the Application for Payment.

§ 9.3.4.1 By signing each Application for Payment, Contractor stipulates and certifies the following: that the information presented is true, accurate, and complete; that the Contractor has made the necessary detailed examinations, audits, and arithmetic verifications that the submitted Work has been completed to the extent represented in the Application for Payment, that the materials and supplies identified in the Application for Payment have been purchased, paid for, and received; that the subcontractors have been paid as identified in the Application for Payment or that the Contractor has been invoiced for same; that he has made the necessary on-site inspections to confirm the accuracy of the Application for Payment; 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; 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; that the Payment Application includes only Work self-performed by Contractor of for which Contractor has been invoiced; and that releases from all subcontractors and materialmen have been obtained in such a form as to constitute an effective release of lien under the laws of the State of Texas covering all Work performed and for which payment has been made by the Owner to the Contractor.

§ 9.3.5 Contractors shall submit digitally one (1) application using AIA Document G702 and G703, Application and

Certificate for Payment, 1992 Edition. All blanks in the form must be completed and signatures of Contractor and Notary Public must be original on each form.

§ 9.3.6 Contractor shall submit Application to the Architect in sufficient time (no later than Thursday at noon) to ensure that the Architect submits Application to the Owner on the first Monday of the Month (or previous business day if Monday is a Holiday as defined in this Agreement), prior to 12:00 pm. Applications will not be accepted on any other day of the week.

§ 9.4 Certificates for Payment

§ 9.4.1 The Architect will, within seven (7) days after receipt of the Contractor's Application for Payment, either issue to the Owner a Certificate for Payment, with a copy to the Contractor, for such amount as the Architect determines is properly due, or notify the Contractor and Owner in writing of the Architect's reasons for withholding certification in whole or in part 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 comprising the Application for Payment, that, to the best of the Architect's knowledge, information and belief, the Work has progressed to the point indicated and that the quality of the Work is in accordance with the Contract Documents. 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. The issuance of a Certificate for Payment will further constitute a representation that the Contractor is entitled to payment in the amount certified. 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 material 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.

§ 9.4.3 The Architect will affix his signature to the same form described in Paragraph 9.3.4 to signify his certification of payment provided the application is otherwise satisfactory.

§ 9.4.4 The issuance of a Certificate for Payment shall constitute a recommendation to the Owner regarding the amount to be paid, this recommendation is not binding on the Owner if the Owner knows of other reasons under the Contract Documents why payment should be withheld.

§ 9.5 Decisions to Withhold Certification

§ 9.5.1 The Architect 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 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. 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 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 opinion to protect the Owner from loss for which the Contractor is responsible, including loss resulting from acts and omissions described in Section 3.3.2, because of

- .1 defective Work not remedied;
- .2 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 of the Contractor to make payments properly to Subcontractors or for labor, materials or equipment;
- .4 reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Sum;
- .5 damage to the Owner or a Separate Contractor;
- .6 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 persistent failure to carry out the Work in accordance with the Contract Documents.

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§ 9.5.2 When the above reasons for withholding certification are removed, certification will be made for amounts previously withheld.

(Paragraphs deleted)

§ 9.6 Progress Payments

§ 9.6.1 After the Architect has issued a Certificate for Payment, the Owner shall make payment in the manner and within the time provided in the Contract Documents, and shall so notify the Architect.

§ 9.6.2 The Contractor shall pay each Subcontractor, no later than seven (7) days after 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.

§ 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 Neither the Owner nor Architect shall have an obligation to pay or to see to the payment of money to a Subcontractor except as may otherwise be required by law.

§ 9.6.5 Payments to material and equipment 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 and 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, shall create any fiduciary liability or tort liability on the part of the Contractor for breach of trust or shall entitle any person or entity to an award of punitive damages against the Contractor for breach of the requirements of this provision.

(Paragraph deleted)

§ 9.6.8 Based upon Applications for Payment and supporting documents including monthly updates of record drawings 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 in the conditions of the Contract as follows:

95% of the proportion of the Contract Sum properly allocable to labor, materials and equipment incorporated in the Work and 95% of the portion of the Contract Sum properly allocable to materials and equipment suitably stored at the site or at some other location agreed upon in writing by the parties; less the aggregate of previous payments in each case; and upon Substantial Completion of the entire work, a sum sufficient to increase the total payments to 95% of the Contract Sum less such retainages as the Architect shall determine for all incomplete work and unsettled claims.

Owner reserves the right to require that conditional Lien Releases be submitted by the Contractor and all subcontractors, sub-subcontractors and major suppliers with each Application for Payment after the first Application for Payment for which payment was made by the Owner for the certified amount for all previous applications for payments. Owner may withhold payment on-line items for which a lien or claim (or similar notice of intent) has been filed, until satisfactory release has been received by Owner.

Contractor shall not withhold as retainage a greater percentage for the Subcontractors or materialmen than the percentage that Owner withheld as retainage from payments to the Contractor.

§ 9.7 Failure of Payment

If the Architect does not issue a Certificate for Payment or notify Contractor of rejection, 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, then the Contractor may, upon seven (7) additional days' written 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 and the Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shut-down, delay and start-up, plus interest as provided for in the Contract Documents.

§ 9.7.1 If the Owner is entitled to reimbursement or payment from the Contractor under or pursuant to the Contract Documents, then such payment shall be made promptly upon demand by the Owner. Any payments that are past due more than thirty (30) days after the Owner's invoice date may result in owner's rejection of Application for Payment.

§ 9.8 Substantial Completion

§ 9.8.1 Substantial Completion is the stage in the progress of the Work when the Work is sufficiently complete for the Owner to occupy, operate, and maintain the Work. Owner and Architect shall make the final determination as to which provisions of the Contract Documents are necessary to meet this criteria, whether or not such requirements are specifically enumerated in this Section or in other portions of the Contract Documents as being specifically required for Substantial Completion.

§ 9.8.1.1 The following items are a partial list of requirements, as applicable to the Project, that must be completed prior to the established Substantial Completion. This is not intended to be an exhaustive list, but a guideline:

1. All fire alarm system components must be completed and demonstrated to the Owner.
2. All inspections by government authorities having jurisdiction over the project must have been finalized, any remedial work required by them must have been completed, and Certificates of Occupancy, local fire marshal and health department approval certificates and similar governmental approval forms must have been issued and copies delivered to the Owner and Architect.
3. All exterior clean-up and landscaping must be complete, including required stand of grass mowed, edged, weeded, and fertilized.
4. All interior shall have been completed and cleaned except minor items which, if complete after occupancy, will not, in the Owner's opinion, cause interference to the Owner's use of the building or any portion thereof. Contractor shall provide list of these specific items, which include punch list and completion items. 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 shall be the sole judge of what constitutes a significantly large number of items.
5. All third-party HVAC air and water balancing must be complete.
6. All energy management systems must be complete, fully operational and demonstrated to the Owner, with graphics transferred to the main server.
7. All emergency/standby generator and low voltage lighting control systems must be complete, fully operational and demonstrated to the Owner.
8. All security systems must be complete, fully operational and demonstrated to the Owner, and must be monitorable from the District's central Police/Security Center.
9. All school communications equipment, telephone systems and P.A. systems must be complete and demonstrated to the Owner.
10. All final lockset cores must be installed and all final Owner directed keying completed.
11. All room plaques and exterior signage must be complete.
12. All Owner demonstrations must be completed including kitchen equipment, HVAC equipment, plumbing equipment, and electrical equipment and all life safety systems.
13. A final certificate of occupancy must be signed by the Contractor and delivered to the Owner.
14. All operation and maintenance manuals are delivered and approved by Architect and Owner ("D-slant" ring binders in duplicate).
15. Health Department Inspections and Municipal Utility District (MUD) and Drainage District and County approvals must be provided.
16. All other reports, testing results, certifications, studies, etc. required by Contract Documents.

§ 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.

§ 9.8.3 Upon receipt of the Contractor's list, the Architect 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, operate, and maintain 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.

§ 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, shall establish responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to the Work and insurance, and shall 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 such Certificate.

§ 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 as required under Article 11 and authorized by public authorities having jurisdiction over the Work. 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. 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, 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 written notice that the Work is ready for final inspection and acceptance, the Architect will promptly make such inspection. When the Architect finds the Work acceptable under the Contract Documents and the Contract fully performed, and the Owner agrees that all closeout requirements have been fulfilled, 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 terms and conditions of 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.

§ 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 for materials and equipment, and other indebtedness 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 and will not be canceled or allowed to expire until at least 30 days' prior written notice has been given to the Owner, (3) a written statement that the Contractor

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knows of no substantial 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 and (5), if required by the Owner, other data establishing payment or satisfaction of obligations, such as receipts, 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.

§ 9.10.3 Prior to final payment, the Contractor shall submit in triplicate (one (1) original and two (2) copies) to the Architect the following completed forms:

1. Contractor's Affidavit of Payment of Debts and Claims, AIA Document G706.
2. Contractor's Affidavit of Release of Liens, AIA Document G706A
3. Consent of Surety to Final Payment, AIA Document G707.
4. General Contractor's Guarantee - notarized
5. Subcontractor's Warrantees from each Subcontractor on Final Subcontractor List
6. All Subcontractors and suppliers and also any other parties that had submitted claims of non-payment shall submit Conditional Lien Releases – notarized. Executed document shall be dated within thirty (30) days of submission of final pay application.
7. Each Offeror (and Subcontractor and supplier submitting a proposal to an Offeror) shall submit a notarized affidavit stating that no asbestos, PCB or lead containing building materials were used on Owner's form.
8. Maintenance, inspection and warranty manuals. Two (2) sets of each bound in a 3-inch "D-slant" ring binder.
9. Record drawings. See Section 3.20.
10. Final Subcontractor List.
11. Refer to Specification Section 01 77 00, Guarantees, Certificates and Project Closeout for any additional information and requirements.
12. Executed TEA Project Compliance Certificate Form (Form 'AL').
13. Executed project Close-Out Form (Form 'AO'), and any additional provisions stated on Form 'AO' as being the responsibility of Contractor.

Documents identified as affidavit must be notarized. All documents requiring signatures must have original signatures (no stamps), and must indicate printed name of signer. All manuals will contain an index listing the information submitted. The index sections will be divided and identified by tabbing each section as listed in the index.

All Manufacturers' warranties must be on manufacturer's original form, indicating project name, and length of warranty.

The Owner may accept certain portions of the work as being complete prior to the acceptance of the entire project. If certain areas are accepted by the Owner as being complete, and if the Contractor has completed all of the requirements for final payment of that portion of work, the Owner may release retainage for that area/portion of work. Amounts of retainage shall be agreed upon by both Owner and Contractor prior to final acceptance of these areas.

Refer to Project Manual for additional requirements.

§ 9.10.4

(Paragraphs deleted)

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 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 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 shall not constitute a waiver of claims.

§ 9.10.5 The making of final payment shall constitute a waiver of Claims by the Owner except those arising from

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- .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; or
- .3 terms of special warranties required by the Contract Documents.

§ 9.10.6 Acceptance of final payment by the Contractor, a Subcontractor or material 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.

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.

§ 10.1.1 Contractor's employees, agents, and Subcontractors and Sub-subcontractors shall not perform any service under this Contract while under the influence of alcohol or any controlled substance. 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.

§ 10.1.2 Contractor has adopted or will adopt its own policy to assure a drug and alcohol-free workplace while performing the Work. 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.

§ 10.1.3 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 Work-free Workforce Policy, Drug-Free Workplace Act of 1988). Owner has also banned the presence of all weapons on the Project Site, whether or not the owner thereof has a permit for a concealed weapon.

§ 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 and other persons who may be affected thereby;
- .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, 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 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 owners and users of adjacent sites and utilities.

§ 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. When use or storage of explosives or other Hazardous Substances (as hereinafter defined) or equipment or unusual construction methods are necessary, the Contractor shall give the Owner reasonable advance notice of the presence or use of such materials, equipment, or methods. Contractor shall be

responsible for any Hazardous Substances Contractor or Contractor's employees, contractors, consultants, subcontractors, sub-subcontractors, materialmen, and suppliers use, store, or otherwise introduce to the Premises.

§ 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, except damage or loss 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.

§ 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.

(Paragraphs deleted)

§ 10.2.8 The Contractor shall be responsible for taking all precautions necessary to protect the work in place from any weather conditions including without limitations to flooding, freezing, high winds, tropical storms, hurricanes, etc. which could cause any potential damage to portions or all work in place. The Contractor shall be responsible for performing all repairs and/or replacement of any work that results from such weather conditions.

§ 10.3 Hazardous Materials

§ 10.3.1 The Contractor is responsible for compliance with any requirements included in the Contract Documents regarding hazardous materials. 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 report the condition to the Owner and Architect in writing.

§ 10.3.2 If requested in writing by the Contractor, 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 verify that it has been rendered harmless. If requested in writing by the Contractor or Architect, 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 such material or substance or who are to perform the task of removal or safe containment of such 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.

(Paragraphs deleted)

§ 10.4 The Owner shall not be responsible under this Section 10.3 for materials or substances the Contractor brings to the site unless such materials or substances are required by the Contract Documents.

§ 10.5 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 Section 4.3.7.

§ 10.6 Asbestos, Lead or PCBs Containing Materials

§ 10.6.1 The contractor and each subcontractor, **sub-subcontractor and suppliers** prior to final payment, shall submit an original notarized statement on their letterhead certifying "to the best of their information, knowledge, and belief asbestos-, lead-, and PCB-containing materials, and have not been used or incorporated into the Work and lead or lead-bearing materials have not been incorporated into potable water systems." For the purpose of definition as used in

this statement, the term "potable water systems" includes, but is not limited to, those water systems for drinking fountains, all sinks, showers, bath tubs, residential and commercial kitchen equipment, ice machines, and hose bibs, as applicable to the project.

§ 10.6.2 To the best knowledge of the Owner, the Architect and his consultants, no products or materials containing asbestos or polychlorinated biphenyl (PCB) or other toxic substances have been specified for this project. No products or materials containing asbestos or PCB are to be incorporated in this project. In the event the Contractor or his Sub-contractors become aware that any products or materials specified, ordered, scheduled for or already incorporated in the work on this project, contain asbestos, or PCB, the situation shall be reported immediately to the Owner and Architect in writing. An acceptable, equal substitute for the product or material in question shall be proposed by the Contractor and the product or material in question, if already onsite or incorporated in the work, shall be removed from the site immediately and returned to the supplier or manufacturer.

ARTICLE 11 INSURANCE AND BONDS

§ 11.1 Contractor's Liability Insurance

(Paragraph deleted)

§ 11.1.1 Refer to Section BD - Insurance and Bonds Requirements for Contractors and Facility Renters Cypress-Fairbanks Independent School District Insurance Management. The Contractor and Contractor's Subcontractors shall purchase and maintain, in a company or companies licensed and admitted by the Texas Department of Insurance to engage in the business of furnishing insurance in the State of Texas, the types and amounts of insurance as set forth in Section BD of the Agreement to protect it and the Owner from claims that may arise out of, or result from, the Contractor's operations under the Contract, whether such operations be by itself, or by any Subcontractor, or by anyone directly or indirectly employed by any of them, or by anyone for whose acts any of them may be liable. All insurance companies shall have an "A-VIII" in Best's Rating Guide and shall be satisfactory to the Owner. No Work will be commenced until all requirements of this Article have been approved by the Owner in writing.

§ 11.1.2 The insurance required by Section BD - Insurance and Bonds Requirements for Contractors and Facility Renters Cypress-Fairbanks Independent School District Insurance Management shall be written for not less than limits of liability specified in the Contract Documents or required by law, whichever coverage is greater. Coverages, whether written on an occurrence or claims-made basis, shall be maintained without interruption from date of commencement of the Work until dates specified in Section BD.

§ 11.1.3 Original Certificates of insurance acceptable to the Owner shall be filed with the Owner prior to commencement of the Work. These certificates and the insurance policies required by this Section BD – Insurance and Bonds Requirements for Contractors and Facility Renters Cypress-Fairbanks Independent School District Insurance Management shall contain a provision that coverages afforded under the policies will not be canceled or allowed to expire until at least thirty (30) days prior written notice has been given to the Owner. If any of the foregoing insurance coverages are required to remain in force after final payment and are reasonably available, an additional certificate evidencing continuation of such coverage shall be submitted with the Final Application for Payment as required by Section 9.10.2. Information concerning reduction of coverage on account of revised limits or claims paid under the General Aggregate, or both, shall be furnished by the Contractor with reasonable promptness in accordance with the Contractor's information and belief.

(Paragraphs deleted)

§ 11.2 Owner's Liability Insurance

§ 11.2.1 The Owner shall be responsible for purchasing and maintaining the Owner's usual liability insurance.

(Paragraphs deleted)

§ 11.3 Project Management Protective Liability Insurance

§ 11.3.1 Optionally, the Owner may require the Contractor to purchase and maintain Project Management Protective Liability insurance from the Contractor's usual sources as primary coverage for the Owner's, Contractor's and Architect's vicarious liability for construction operations under the Contract. Unless otherwise required by the Contract Documents, the Owner shall reimburse the Contractor by increasing the Contract Sum to pay the cost of purchasing and maintaining such optional insurance coverage, and the Contractor shall not be responsible for purchasing any other liability insurance on behalf of the Owner. The minimum limits of liability purchased with such coverage shall be equal to the aggregate of the limits required for Contractor's Liability Insurance under Section 11.1.1.

(Paragraphs deleted)

§ 11.3.2 To the extent damages are covered by Project Management Protective Liability insurance, the Owner, Contractor and Architect waive all rights against each other for damages, except such rights as they may have to the proceeds of such insurance. The policy shall provide for such waivers of subrogation by endorsement or otherwise.

§ 11.4 Performance Bond and Payment Bond

§ 11.4.1 The Owner requires the Contractor to furnish payment and performance bonds covering faithful performance of the Contract and payment of obligations arising thereunder as stipulated in bidding requirements or specifically required in the Contract Documents on the date of execution of the Contract in a total amount equal to 100% of the Contract Sum and in conformity with applicable law. 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 the Project. 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 a reinsurer does not exceed ten percent (10%) of the reinsurers capital and surplus.

§ 11.4.2 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 permit a copy to be made.

§ 11.4.3 The Contractor shall deliver the required Bonds to the Owner not later than the date of the preconstruction meeting if the Contract has been executed by Owner. All Bonds will be reviewed and approved by the Owner for compliance with the Contract Documents prior to the Contractor mobilizing onsite. Upon Owner approval, the Contractor will be allowed to mobilize onsite.

§ 11.4.4 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.

§ 11.4.5 Bonds shall guarantee the faithful performance of all the covenants, stipulations, and agreements of the Contract. Bonds shall be signed by an agent resident in the State of Texas and date of 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, the 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) days after notice to do so. In default thereof, all payment or money due to the Contractor may be withheld until Contractor provides additional surety.

§ 11.4.6 It is distinctly understood that no mechanic, contractor, Contractor, materialman, vendor, artisan or laborer, skilled or unskilled, shall have, claim or acquire any lien upon the Project or any of the improvements in the Project, nor upon any of the land upon which the Project is located.

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.

§ 12.1.2 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, costs of uncovering and replacement shall, by appropriate Change Order, be at the Owner's expense. If such Work is not in accordance with the Contract Documents, such costs and the cost of correction shall be at the Contractor's expense unless the condition was caused by the Owner or a separate contractor in which event the Owner shall be responsible for payment of such costs.

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§ 12.2 Correction of Work

§ 12.2.1 Before or After Substantial Completion

The Contractor shall promptly correct Work rejected by the Architect or failing to conform to the requirements of the Contract Documents, whether discovered before or after 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 (1) 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 an 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 written 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 2.4.

§ 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.

(Paragraph deleted)

§ 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, whether completed or partially completed, of the Owner or separate contractors 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 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 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.

§ 12.3 Acceptance of Nonconforming Work

§ 12.3.1 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

§ 13.1.1 The Contract shall be governed by Texas law and mandatory and exclusive venue for any disputes shall be in Harris County, Texas.

§ 13.2 Successors and Assigns

§ 13.2.1 The Owner and Contractor respectively bind themselves, their partners, successors, assigns and legal representatives to the other party hereto and to partners, successors, assigns and legal representatives of such other party in respect to covenants, agreements and obligations contained in the Contract Documents. Neither party to the Contract shall assign the Contract as a whole without written consent of the other. If either party attempts to make such

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an assignment without such consent, that party shall nevertheless remain legally responsible for all obligations under the Contract.

(Paragraph deleted)

§ 13.3 Written Notice

Written notice shall be deemed to have been duly served if delivered in person to the individual, to a member of the firm or entity, or to an officer of the corporation for which it was intended; or if delivered at, or sent by registered or certified mail or by courier service providing proof of delivery to, the last business address known to the party giving notice.

(Paragraphs deleted)

§ 13.4 Rights and Remedies

§ 13.4.1 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.

§ 13.4.2 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 there under, except as may be specifically agreed in writing.

(Paragraphs deleted)

§ 13.5 Tests and Inspections

§ 13.5.1 Tests, inspections and approvals of portions of the Work required by the Contract Documents or by laws, ordinances, rules, regulations or orders of public authorities having jurisdiction shall be made at an appropriate time. 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. 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 which do not become requirements until after bids are received or negotiations concluded.

§ 13.5.2 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 13.5.1, 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 13.5.3, shall be at the Owner's expense.

§ 13.5.3 If such procedures for testing, inspection or approval under Sections 13.5.1 and 13.5.2 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, their Consultants, or Owner's Third Party Consultant services, and expenses shall be at the Contractor's expense.

§ 13.5.4 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.

§ 13.5.5 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.

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

§ 13.6 Commencement of Statutory Limitation Period

§ 13.6.1 As between the Owner and Contractor:

- .1 Before Substantial Completion. As to acts or failures to act occurring prior to the relevant date of Substantial Completion, any applicable statute of limitations shall commence to run and any alleged

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cause of action shall be deemed to have accrued in any and all events not later than such date of Substantial Completion;

- .2 Between Substantial Completion and Final Certificate for Payment. As to acts or failures to act occurring subsequent to the relevant date of Substantial Completion and prior to issuance of the final Certificate for Payment, any applicable statute of limitations shall commence to run and any alleged cause of action shall be deemed to have accrued in any and all events not later than the date of issuance of the final Certificate for Payment; and
- .3 After Final Certificate for Payment. As to acts or failures to act occurring after the relevant date of issuance of the final Certificate for Payment, any applicable statute of limitations shall commence to run and any alleged cause of action shall be deemed to have accrued in any and all events not later than the date of any act or failure to act by the Contractor pursuant to any Warranty provided under Section 3.5, the date of any correction of the Work or failure to correct the Work by the Contractor under Section 12.2, or the date of actual commission of any other act or failure to perform any duty or obligation by the Contractor or Owner, whichever occurs last.

§ 13.7 Refer to Specification Sections 01 35 23, 01 35 23.1 and 01 35 23.2 - Special Owner Requirements for additional requirements to be included as part of the Contract.

§ 13.8 The Owner shall have the right to examine, copy and/or audit the books and other records in possession of the Contractor relating to this Contract at any time deemed necessary by the Owner.

ARTICLE 14 TERMINATION OR SUSPENSION OF THE CONTRACT

§ 14.1 Termination by the Contractor

§ 14.1.1 The Contractor may terminate the Contract if the Work is stopped for a period of sixty (60) consecutive days through no act or fault of the Contractor or a Subcontractor, Sub-subcontractor or their agents or employees or any other persons or entities performing portions of the Work under direct or indirect contract with the Contractor, for any of the following reasons:

- .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;
- .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 payment on a Certificate for Payment within the time stated in the Contract Documents; or
- .4 The Owner has failed to furnish to the Contractor promptly, upon the Contractor's request, reasonable evidence as required by Section 2.2.1.

§ 14.1.2 The Contractor may terminate the Contract if, through no act or fault of the Contractor or a Subcontractor, Sub-subcontractor or their agents or employees or any other persons or entities performing portions of the Work under direct or indirect contract with the Contractor, repeated suspensions, delays or interruptions of the entire Work by the Owner as described in 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.

§ 14.1.3 If one of the reasons described in Section 14.1.1 or 14.1.2 exists, the Contractor may, upon seven (7) days' written notice to the Owner and Architect, terminate the Contract and recover from the Owner payment for Work properly executed and for proven loss with respect to materials, equipment, tools, and construction equipment and machinery, including reasonable miscellaneous fees, profit, and damages.

§ 14.1.4 If the Work is stopped for a period of sixty (60) consecutive Calendar Days through no act or fault of the Contractor or a Subcontractor or their agents or employees or any other persons performing portions of the Work under contract with the Contractor 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 (7) additional days' written notice to the Owner and the Architect, terminate the Contract and recover from the Owner as provided in Section 14.1.3.

§ 14.2 TERMINATION BY THE OWNER FOR CAUSE

(Paragraphs deleted)

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§ 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 for materials or labor in accordance with the respective agreements between the Contractor and the Subcontractors;
- .3 repeatedly disregards laws, ordinances, or rules and regulations, or orders of a public authority having jurisdiction; or
- .4 otherwise is guilty of substantial breach of a provision of the Contract Documents.
- .5 fails to furnish the Owner, upon written request, with assurances satisfactory to the Owner, evidencing the Contractor's ability to complete the Work in compliance with all the requirements of the Contract Documents;
- .6 engages in serious or repeated worker misconduct in violation of Article 3.3.2;
- .7 engages in conduct that would constitute a violation of state or federal criminal law, including but not limited to, the laws prohibiting certain gifts to public servants, or engages in conduct that would constitute a violation of the Owner's ethics or conflict of interest policies; or
- .8 fails to proceed continuously and diligently with the construction and completion of the Work, except as permitted under the Contract Documents.

§ 14.2.2 When any of the above reasons exist, 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 (7) days' written 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 the site and all materials, equipment, tools, and construction equipment and machinery thereon owned by the Contractor;
- .2 Accept assignment of subcontracts pursuant to 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.

(Paragraph deleted)

§ 14.2.3 The parties hereby agree that: 1) if an order for relief is entered on behalf of the Contractor, pursuant to Chapter 11 of the U.S. Bankruptcy Code; 2) if any other similar order is entered under any debtor relief laws; 3) if Contractor makes assignments for the benefit of one or more of its creditors; 4) if a receiver is appointed for the benefit of its creditors; or 5) if a receiver is appointed on account of its insolvency, any such event could impair or frustrate Contractor's performance of the Contract Documents. Accordingly, it is agreed that upon occurrence of any such event, Owner shall be entitled to request of Contractor or its successor in interest, adequate assurance of future performance in accordance with the terms and conditions of the Contract Documents. Failure to comply with such request within ten (10) days of delivery of the request shall entitle Owner to terminate the Contract and to the accompanying rights set forth in Subparagraphs 14.2.1 through 14.2.6. In all events, pending receipt of adequate assurance of performance and actual performance in accordance with the Contract Documents, Owner shall be entitled to proceed with the Work with Owner's own forces or with other Contractors on a time and material or other appropriate basis, the cost of which will be charged against the Contract Sum.

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

§ 14.2.5 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 Architect, upon application, and this obligation for payment shall survive termination of the Contract.

§ 14.2.6 Contractor hereby assigns the Owner any and all claims for overcharges associated with this Contract which arise under the antitrust laws of the United States, 15 U.S.C.A. Section 1 ET.SEQ. (1973).

§ 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, in whole or in part for such period of time as the Owner may determine.

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

- .1 that performance is, 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.

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

§ 14.4.3 In case of such termination for the Owner's convenience, the Contractor shall be entitled to receive payment from the Owner on the same basis provided in Section 14.1.3.

(Paragraphs deleted)

ARTICLE 15 LABOR STANDARDS

(Paragraphs deleted)

§ 15.1 PREVAILING WAGE RATES

(Paragraphs deleted)

§ 15.1.1. Contractor, Contractor's Subcontractors and Sub-subcontractors shall pay all workers not less than the general prevailing rate of per diem wages for work of a similar character where the project is located as detailed in the "Minimum Wage Schedule" in section CB of the specifications, or as otherwise provided in the Contract Document. Wages listed are minimum rates only. However, no claims for additional compensation above the Contract Sum shall be considered by the Owner because of payments of wage rates in excess of the applicable rate provided herein. Texas Government Code § 2258.001 *et seq.*

(Paragraphs deleted)

§ 15.1.2 Contractor shall forfeit, as a penalty to the Owner, \$60 for each laborer, worker, or mechanic, employed for each calendar day or part of the day that the worker is paid less than the wage rates stipulated in the Contract Documents.

(Paragraphs deleted)

§ 15.1.3 Owner reserves the right to receive and review payroll records, payment records, and earning statements of employees of Contractor, and of Contractor's Subcontractors and Sub-subcontractors.

(Paragraphs deleted)

§ 15.1.4 If no prevailing wage rate schedule is made part of the Contract Documents, then the parties shall use the wage rate determined by the U.S. Department of Labor in accordance with the Davis-Bacon Act, 40 U.S.C. § 276a.

(Paragraphs deleted)

DOCUMENT BA

CONTRACT DOCUMENTS

I. CONSTRUCTION CONTRACT AGREEMENT

- A. The contract for the construction of the project shall be executed by the successful Offeror on the AIA Document A101™-2017, as amended "Standard Form of Agreement between Owner and Contractor." A Notice to Proceed shall be issued 10 days following Board Award.
- B. A sample of this AIA Document A101™-2017, as amended is attached here within.

II. CONDITIONS OF THE CONTRACT

- A. General Conditions:
 - 1. The General Conditions of the Contract for Construction AIA Document A201™-2017, as supplemented and amended herein, constitutes the General Conditions and is hereby specifically made part of the Contract Documents.
- B. Supplementary Conditions:
 - 1. For modifications to the General Conditions of the Contract for Construction AIA Document A201™-2017, as amended refer to Section CB for the Supplementary Conditions.

END OF DOCUMENT

FORM BB

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 this _____ day
of _____, _____.

2024 CY RIDGE HS RENOVATION
CYPRESS-FAIRBANKS INDEPENDENT SCHOOL DISTRICT
CYPRESS-FAIRBANKS I.S.D. PROPOSAL NUMBER: 24-02-5752R-RFP

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 22.53 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 _____, _____.

Principal (Seal)

Surety Address By: _____
Signature and Printed Name

Surety Telephone Number _____
Surety (Seal)

By: _____
Attorney-in-Fact: Signature and Printed Name

FORM BC

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, _____
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 this _____ day
of _____, _____.

**2024 CY RIDGE HS RENOVATION
CYPRESS-FAIRBANKS INDEPENDENT SCHOOL DISTRICT
CYPRESS-FAIRBANKS I.S.D. PROPOSAL NUMBER: 24-02-5752R-RFP**

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 22.53 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 _____, _____.

Witness: _____ (Seal)
Principal

_____ By: _____
Signature and Printed Name

Witness: _____ (Seal)
Surety

_____ By: _____
Attorney-in-Fact: Signature and Printed Name

_____ Surety Address
_____ Surety Telephone Number

SECTION BD

INSURANCE AND BONDS REQUIREMENTS FOR CONTRACTORS AND FACILITY RENTERS

**CYPRESS-FAIRBANKS INDEPENDENT SCHOOL DISTRICT
INSURANCE MANAGEMENT**

1.0 GENERAL

- A. The District shall require that the following insurance requirements be met on public works contracts:
1. No Work will be commenced until all requirements of this Section have been approved by the District in writing.
 2. The District shall be furnished a Declaration of Insurance evidencing all policies and endorsements required by this Section prior to proceeding with any work.
 3. The insurance shall contain a provision that at least thirty days prior written notice shall be given to the District in the event of cancellation, material change, or non-renewal.
 4. Insurance shall be underwritten by a company rated not less than B+ VII in Best's latest published guide.
 5. There shall be a hold harmless agreement in which the Contractor assumes liability on the contract and holds the School District harmless.
 6. The Contractor shall purchase and maintain in force the following kinds of insurance and bonds for operations under construction contracts and as specified in each section.
 7. No deletions/exclusions from standard coverage form are allowed without the written consent of Cypress-Fairbanks Independent School District.
 8. Furnish copies of subcontractors Certificates of Insurance to Owner.
 9. Furnish copies of Worker Compensation Documents to Owner.

2.0 CASUALTY INSURANCE

- A. Worker's Compensation Insurance Coverage

Definitions:

Certificate of coverage ("Certificate") - A copy of a certificate of insurance, a certificate of authority to self-insure issued by the commission, or a coverage agreement (TWCC-81, TWCC-82, TWCC-83, or TWCC-84), showing statutory workers' compensation insurance coverage for the person's or entity's employees providing services on a project, for the duration of the project.

Duration of the project - includes the time from the beginning of the work on the project until one (1) year after Substantial Completion of the project.

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 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 that furnishes persons to provide services on the project. "Services" shall 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.

1. 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 401.011 (44) for all employees of the contractor providing services on the project for the duration of the project.

2. The contractor must provide a certificate of coverage to the governmental entity prior to being awarded the contract. The certificate shall show Cypress-Fairbanks Independent School District as the certificate holder. The policy must be endorsed to provide a “waiver of subrogation in favor of Cypress-Fairbanks Independent School District.”
3. 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 governmental entity showing the coverage has been extended.
4. The contractor shall obtain from each person providing services on a project, and provide to the governmental entity:
 - a. a certificate of coverage, prior to that person beginning work on the project, so the governmental entity will have on file certificates of coverage showing coverage for all persons providing services on a project; and
 - b. 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.
5. The contractor shall retain all required certificates of coverage for the duration of the project and two (2) years thereafter.
6. The contractor shall notify the governmental entity in writing by certified mail or personal delivery, within 10 days after the contractor knows or should know, of any change that materially affects the provision of coverage of any person providing services on the project.
7. The contractor shall post on each project site a notice, in the text, form and manner prescribed by the Texas Workers’ Compensation Commission, 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.
8. The contractor shall contractually require each person with whom it contracts to provide services on a project, to:
 - a. 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. The policy must be endorsed to provide a “waiver of subrogation” in favor of Cypress-Fairbanks Independent School District;
 - b. 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. The certificate shall show Cypress-Fairbanks Independent School District as the certificate holder;
 - c. 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;
 - d. obtain from each other person with whom it contracts, and provide to the contractor:
 - 1) a certificate of coverage, prior to the other person beginning work on the project; and

- 2) 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.
 - e. retain all required certificates of coverage on file for the duration of the project and for one year thereafter;
 - f. notify the governmental entity in writing by certified mail or personal delivery, within 10 days after the person knew or should have known, of any change that materially affects the provisions of coverage of any person providing services on the project; and
 - g. contractually require each person with whom it contracts to perform as required by paragraphs a - g, with the certificates of coverage to be provided to the person for whom they are providing services.
9. By signing this contract or providing or causing to be provided a certificate of coverage, the contractor is representing to the governmental entity 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 self-insured, with the commission's 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.
10. The contractor's failure to comply with any of these provisions is a breach of contract by the contractor which entitles the governmental entity to declare the contract void if the contractor does not remedy the breach within ten days after receipt of notice of breach from the governmental entity.
11. The Contractor shall post the following language:

REQUIRED WORKERS' COMPENSATION COVERAGE

"The law requires that each person working on this site or providing services related to this construction project must be covered by workers' compensation insurance. This includes persons providing, hauling, or delivering equipment or materials, or providing labor or transportation or other service related to the project, regardless of the identity of their employer or status as an employee." Furnish copies of Workers' Compensation coverage for each person working on the project.

"Call the Texas Workers' Compensation Commission at (512) 440-3789 to receive information on the legal requirements for coverage, to verify whether your employer has provided the required coverage, or to report an employer's failure to provide coverage."

B. Commercial General Liability Insurance (Occurrence basis only).

| | | |
|---------------------------------|----------------|-----------------|
| Each Occurrence Limit | | \$1,000,000 CSL |
| Products/Completed Operations | Aggregate | \$1,000,000 |
| Personal and Advertising Injury | Occurrence | \$1,000,000 |
| Fire Damage, Legal Liability | Any one fire | \$50,000 |
| Medical Expenses | Any one person | \$5,000 |

- C. The Owner shall be named as an additional insured by endorsement on the Contractor's policy as to the subject job.

2.1 AUTOMOBILE LIABILITY INSURANCE

- A. Business (Commercial) Automobile Liability Insurance
 - 1. Coverage for all owned, non-owned and hired vehicles:

Bodily Injury/Property Damage \$1,000,000 CSL

2.2 UMBRELLA LIABILITY INSURANCE (EXCESS) \$1,000,000

- A. The Owner shall be named as an additional insured on the Contractor's policy as to the subject job.
- B. This policy shall provide coverage over the Workmen's Compensation, Commercial General Liability and Business Automobile Liability policies.

2.3 PROPERTY INSURANCE (BUILDER'S RISK/INSTALLATION FLOATER)

- A. The policy shall be written in the name of the Owner, Contractor, and subcontractors as their interest may appear.
- B. The policy shall be written on an all risk basis for physical loss or damage and include theft, vandalism, malicious mischief.
- C. The amount of coverage shall be for the full insurable value of work.
- D. The deductible shall not be over \$1,000.00 without the approval of the Owner. (Deductible losses shall be paid by the Contractor.)
- E. The policy shall include an endorsement allowing Owner occupancy, and the insurance shall not be canceled or altered on account of partial occupancy prior to completion.
- F. A subrogation clause shall waive subrogation as to the Contractor, subcontractor, sub-subcontractors, the Owner and his employees and representatives.
- G. The original builders risk policy shall be furnished to the Owner prior to start of the job and maintained through Substantial Completion

3.0 BONDS

- A. Bonds are required for public works contracts under the following circumstances:
 - 1. Performance Bond and Labor and Material Payment Bond, each in a personal sum equal to 100% of contract sum if the formal contract is in excess of \$25,000.00.
 - 2. A Proposal Bond or Proposal Security in the amount of 10% of any proposal of \$25,000.00 or more must be submitted with formal proposals on public works contracts or as otherwise specified in each contract.
 - 3. Copies of the bonds shall be filed with the county clerk and the owner shall receive a file receipt.
 - 4. Performance and Payment Bonds shall remain in force for one (1) year after substantial completion.
 - 5. The Work will not be started until the bonds and issuing companies have been accepted in writing as satisfactory by the Owner.
 - 6. The original bonds will be delivered to the Owner with an attached authorized power of attorney.

END OF DOCUMENT

**SECTION CA
APPLICATION AND CERTIFICATION FOR PAYMENT
CHECK LIST AND TRANSMITTAL**

Date: _____ Application for Payment No.: _____
 Project: 2024 Cy Ridge HS Renovation Architect's Proposal Number: 33AC23221
 Owner: Cypress-Fairbanks Independent School District Page _____
 Contractor: _____ Architect: Architects

Transmitted herewith is one (1) completed copy of the above referenced Application and Certificate for Payment. By initialing each item listed below, the undersigned certifies that he/she has personally checked and determined that each of the items is in compliance with the requirements of the Contract Documents.

| Item | Description | CONTRACTOR Initial to Acknowledge Compliance | ARCHITECT Initial to Acknowledge Compliance | OWNER Initial to Acknowledge Compliance | Notes, Exceptions |
|------|---|---|--|--|-------------------|
| A | One (1) complete copy of the above Referenced Application and Certificate for Payment, signed and Notarized, are enclosed. | | | | |
| B | The grand totals of the Continuation Sheet match the amounts shown on the Application and Certificate for Payment. | | | | |
| C | Percentage drawn for Supervision and General Conditions is less than or equal to the Continuation Sheet grand total percentage complete. | | | | |
| D | Unconditional Release for each lien or claim that is applicable to period covered in Previously Approved Pay Application. Release must identify exact amount and period as stated in the Application for Payment. | | | | |
| E | Conditional Release for each lien or claim that is applicable to period covered in Current Pay Application. Release must identify exact amount and period as stated in the Application for Payment. | | | | |
| F | One (1) copy of Stored Materials Inventory List and Invoices enclosed for each line item of stored materials. | | | | |
| G | One (1) updated Construction Schedule enclosed. | | | | |
| H | Recovery Plan from GC if project is behind schedule. | | | | |
| I | Anticipated Weather Delay Log | | | | |
| J | Construction Progress Photographs enclosed. | | | | |
| K | Back charges are paid to date (e.g. Operations (Custodial)/Maintenance overtime, badges and retesting.) | | | | |

Submitted by (Signature): _____
 Name (Printed or Typed): _____
 Title: _____
 Date: _____

SECTION CB

**SUPPLEMENTARY CONDITIONS TO THE
GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION AS AMENDED**

Add the following Subparagraph:

1.1.11 DESCRIPTION OF PARTIES

The following definitions apply to parties named in the Contract Documents.

1. Owner: Cypress-Fairbanks Independent School District
 Facilities & Construction Department
 11430-B Perry Road
 Houston, Texas 77064
 Phone: (281) 897-4057
 Representative: Jesse Clayburn, Asst. Superintendent of Facilities & Construction

2. Architect: Page Architects
 1100 Louisiana Street, Suite One
 Houston, Texas 77002

3. MEP Salas O'Brien
Engineer: 738 Highway 6 South, Ste. 615
 Houston, Texas 77079
 Phone: (281) 945-8888

4. Structural: Dally & Associates, Inc.
 9800 Richmond Ave., Ste. 460
 Houston, Texas 77042

5. Civil Brooks & Sparks, Inc.
Consulting: 21020 Park Row Dr.
 Katy, Texas 77449

2.2 INFORMATION AND SERVICES REQUIRED OF THE OWNER

Add the following Subparagraph:

- 2.2.6** The Contractor will be furnished, free of charge, **ten (10)** sets of drawings, specifications, and addenda, for pickup by the Contractor from the office of the Architect.

15.1 PREVAILING WAGE RATES

- 15.1.3** Prevailing Wage Rate Determination Information follows on the *next page*.

15.1 PREVAILING WAGE RATES

Prevailing Wage Rate Determination Information

The following information is from Chapter 2258 Texas Government Code:

Sec. 2258.021. Right to be Paid Prevailing Wage Rates.

- (a) A worker employed on a public work by or on behalf of the state or a political subdivision of the state shall be paid:
 - (1) not less than the general prevailing rate of per diem wages for work of a similar character in the locality in which the work is performed; and
 - (2) not less than the general prevailing rate of per diem wages for legal holiday and overtime work.
- (b) Subsection (a) does not apply to maintenance work.
- (c) A worker is employed on a public work for the purposes of this section if the worker is employed by a contractor or subcontractor in the execution of a contract for the public work with the state, a political subdivision of the state, or any officer or public body of the state or a political subdivision of the state.

Sec. 2258.023. Prevailing Wage Rates to be paid by Contractor and Subcontractor; Penalty.

- (a) The contractor who is awarded a contract by a public body or a subcontractor of the contractor shall pay not less than the rates determined under Section [2258.022](#) to a worker employed by it in the execution of the contract.
- (b) A contractor or subcontractor who violates this section shall pay to the state or a political subdivision of the state on whose behalf the contract is made, \$60 for each worker employed for each calendar day or part of the day that the worker is paid less than the wage rates stipulated in the contract. A public body awarding a contract shall specify this penalty in the contract.
- (c) A contractor or subcontractor does not violate this section if a public body awarding a contract does not determine the prevailing wage rates and specify the rates in the contract as provided by Section [2258.022](#).
- (d) The public body shall use any money collected under this section to offset the costs incurred in the administration of this chapter.
- (e) A municipality is entitled to collect a penalty under this section only if the municipality has a population of more than 10,000.

Sec. 2258.051. Duty of Public Body to Hear Complaints and Withhold Payment.

A public body awarding a contract, and an agent or officer of the public body, shall:

- (1) take cognizance of complaints of all violations of this chapter committed in the execution of the contract; and
- (2) withhold money forfeited or required to be withheld under this chapter from the payments to the contractor under the contract, except that the public body may not withhold money from other than the final payment without a determination by the public body that there is good cause to believe that the contractor has violated this chapter.

Prevailing Wage Rates – School Construction Trades

June 1, 2022

Texas Gulf Coast Area

| CLASSIFICATION | 2022 HOURLY RATE |
|--------------------------------------|---------------------|
| ASBESTOS WORKER | \$21.13 |
| BRICKLAYER; MASON | \$25.32 |
| CARPENTER; CASEWORKER | \$23.38 |
| CARPET LAYER; FLOOR INSTALLER | \$25.12 |
| CONCRETE FINISHER | \$23.40 |
| DATA COMM/TELE COMM | \$23.50 |
| DRYWALL INSTALLER; CEILING INSTALLER | \$26.65 |
| ELECTRICIAN | \$25.93 |
| ELEVATOR MECHANIC | \$28.80 |
| FIREPROOFING INSTALLER | \$22.25 |
| GLAZIER | \$22.30 |
| HEAVY EQUIPMENT OPERATOR | \$22.40 |
| INSULATOR | \$20.50 |
| IRONWORKER | \$25.50 |
| LABORER, HELPER | \$16.71 |
| LATHERER; PLASTERER | \$23.25 |
| LIGHT EQUIPMENT OPERATOR | \$20.50 |
| METAL BUILDING ASSEMBLER | \$21.10 |
| MILLWRIGHT | \$33.63 |
| PAINTER; WALL COVERING INSTALLER | \$19.60 |
| PIPEFITTER | \$26.97 |
| PLUMBER | \$26.71 |
| ROOFER | \$20.50 |
| SHEET METAL WORKER | \$19.90 |
| SPRINKLER FITTER | \$26.13 |
| STEEL ERECTOR | \$23.25 |
| TERRAZZO WORKER | \$23.50 |
| TILE SETTER | \$19.58 |
| WATERPROOFER; CAULKER | \$19.88 |

Prevailing Wage Rates
Worker Classification Definition Sheet

| CLASSIFICATION | DEFINITION |
|----------------------------------|--|
| ASBESTOS WORKER | Worker who removes and disposes of asbestos materials. |
| BRICKLAYER; MASON | Craftsman who works with masonry products, stone, brick, block, or any material substituting those materials and accessories. |
| CARPENTER; CASEWORKER | Worker who builds wood structures or structures of any material which has replaces wood. Includes rough and finish carpentry, hardware, and trim. |
| CARPET LAYER; FLOOR INSTALLER | Worker who installs carpets and /or floor coverings, vinyl tile. |
| CONCRETE FINISHER | Worker who floats, trowels, and finishes concrete. |
| DATA COMM/TELE COMM | Worker who installs data/telephone and television cable and associate equipment and accessories. |
| DRYWALL; CEILING INSTALLER | Worker who installs metal framed walls and ceiling, drywall coverings, ceiling grids, and ceilings. |
| ELECTRICIAN | Skilled craftsman who installs or repairs electrical wiring and devices. Includes fire alarm systems and HVAC electrical controls. |
| ELEVATOR MECHANIC | Craftsman skilled in the installation and maintenance of elevators. |
| FIREPROOFING INSTALLER | Worker who sprays or applies fire proofing materials. |
| GLAZIER | Worker who installs glass, glazing, and glass framing. |
| HEAVY EQUIPMENT OPERATOR | Includes but not limited to all CAT tractors, all derrick-powered, all power operated cranes, back-hoes, back-fillers, power operated shovels, winch trucks, and all trenching machines. |
| INSULATOR | Worker who applies, sprays, or installs insulation. |
| IRONWORKER | Skilled craftsman who erects structural steel framing and installs structural concrete Rebar. |
| LABORER, HELPER | Worker qualified for only unskilled or semi-skilled work. Lifting, carrying materials or tools, hauling, digging, clean up. |
| LATHERER; PLASTERER | Worker who installs metal framing and lath. Worker who applies plaster to lathing and installs associated accessories. |
| LIGHT EQUIPMENT OPERATOR | Includes but not limited to, air compressors, truck crane drivers, flex planes, building elevators, form graders, concrete mixers less than 14cf), conveyers. |
| METAL BUILDING ASSEMBLER | Worker who assembles pre-made metal buildings. |
| MILLWRIGHT | Mechanic specializing in the installation of heavy machinery, conveyance, wrenches, dock levelers, hydraulic lifts, and align pumps. |
| PAINTER; WALL COVERING INSTALLER | Worker who prepares wall surfaces and applies paint and/or wall coverings, tape, and bedding. |
| PIPEFITTER | Trained worker who installs piping systems, chilled water piping and hot water (boiler) piping, pneumatic tubing controls, chillers, boilers, and associated mechanical equipment. |
| PLUMBER | Skilled craftsman who installs domestic hot and cold water piping, waste piping, storm system piping, water closets, sinks, urinals, and related work. |
| ROOFER | Worker who installs roofing materials, Bitumen (asphalt and coal tar) felts, flashings, all types of roofing membranes, and associated products. |
| SHEET METAL WORKER | Worker who installs sheet metal products, Roof metal, flashings and curbs, ductwork, mechanical equipment, and associated metals. |
| SPRINKLER FITTER | Worker who installs fire sprinklers systems and fire protectant equipment. |
| STEEL ERECTOR | Worker who erects and dismantles structural steel frames of buildings and other structures. |
| TERRAZZO WORKER | Craftsman who places and finishes Terrazzo |
| TILE SETTER | Worker who prepares wall and/or floor surfaces and applies ceramic tiles to these surfaces. |
| WATERPROOFER; CAULKER | Worker who applies water proofing material to buildings. Products include sealant, caulk, sheet membranes, and liquid membranes, sprayed, rolled, or brushed. |

END OF DOCUMENT

Section CC

Right of Audit - Examination of Records

1. Records for all contracts, specifically including but not limited to lump sum contracts (i.e. fixed price or stipulated sum contracts), unit price, cost plus or time & material contracts with or without a guaranteed maximum (or not-to-exceed amounts) shall upon reasonable notice be open to inspection and subject to audit, scanning, and/or reproduction during normal business working hours. Such audits may be performed by any Owner's representative, or any outside representative engaged by Owner for the purpose of examining such records. The Owner or its designee may conduct such audits or inspections throughout the term of this contract and for a period of three years after final payment or longer if required by law. Owner's representatives may (without limitation) conduct verifications such as counting employees at the Construction Site, witnessing the distribution of payroll, verifying information and amounts through interviews and written confirmations with Contractor employees, field and agency labor, subcontractors, and vendors.
2. Contractor's "records" as referred to in this Exhibit shall include any and all information, materials and data of every kind and character, including without limitation, records, books, papers, documents, subscriptions, recordings, agreements, purchase orders, leases, contracts, commitments, arrangements, notes, daily diaries, superintendent reports, drawings, receipts, vouchers and memoranda, and any and all other agreements, sources of information and matters that may in Owner's judgment have any bearing on or pertain to any matters, rights, duties or obligations under or covered by any Contract Document. Such records shall include (hard copy, as well as computer readable data if it can be made available), written policies and procedures; time sheets; payroll registers; payroll records; cancelled payroll checks; subcontract files (including proposals of successful and unsuccessful bidders, bid recaps, negotiation notes, etc.); original bid estimates; estimating work sheets; correspondence; change order files (including documentation covering negotiated settlements); backcharge logs and supporting documentation; invoices and related payment documentation; general ledger, information detailing cash and trade discounts earned, insurance rebates and dividends; and any other contractor records which may have a bearing on matters of interest to the Owner in connection with the contractor's dealings with the Owner (all foregoing hereinafter referred to as "records") to the extent necessary to adequately permit evaluation and verification of any or all of the following:
 - a) Compliance with contract requirements for deliverables
 - b) Compliance with approved plans and specifications
 - c) Compliance with Owner's business ethics expectations
 - d) Compliance with contract provisions regarding the pricing of change orders
 - e) Accuracy of contractor representations regarding the pricing of invoices
 - f) Accuracy of contractor representations related to claims submitted by the contractor or any of his payees.
3. Contractor shall require all payees (examples of payees include subcontractors, material suppliers, insurance carriers, etc.) to comply with the provisions of this article by including the requirements hereof in a written contract agreement between Contractor and payee. Contractor will ensure that all payees (including those entering into lump sum contracts) have the same right to audit provisions contained in this contract.
4. Owner's authorized representative(s) shall have reasonable access to the Contractor's facilities, shall be allowed to interview all current or former employees to discuss matters pertinent to the performance of this contract and shall be provided adequate and appropriate workspace, in order to conduct audits in compliance with this article.
5. If an audit inspection or examination in accordance with this article, discloses overpricing or overcharges to the Owner (of any nature) by the Contractor and/or the Contractor's Subcontractors in excess of \$100,000 in addition to making adjustments for the overcharges, the reasonable actual cost of the Owner's audit shall be reimbursed to the Owner by the Contractor. Any adjustments and/or payments which must be made as a result of any such audit or inspection of the Contractor's invoices and/or records shall be made within a reasonable amount of time (not to exceed 90 days) from presentation of Owner's findings to Contractor.

Section CC

Right of Audit – Records to Be Provided to Owner’s Representatives Upon Request

In addition, to the normal paperwork documentation the Contractor typically furnishes to the Owner, in order to facilitate efficient use of Owner resources when reviewing and/or auditing the Contractor’s billings and related reimbursable cost records, the Contractor agrees to furnish (upon request) the following types of information in the specified computer (PC) readable file format(s):

| Type of Record | PC Readable File Format |
|--|-------------------------|
| Monthly Job Cost Detail | .pdf and Excel |
| Detailed job Cost History To Date | .pdf and Excel |
| Monthly Labor Distribution detail (if not already separately detailed in the Job Cost Detail) | .pdf and Excel |
| Total Job to date Labor Distrubution detail (if not already included in the detailed Job Cost History to date) | .pdf and Excel |
| Employee Timesheets documenting time worked by all individuals who charge reimbursable time to the project | .pdf |
| Daily Foreman Reports listing names and hours and tasks of personnel who worked on the project | .pdf |
| Daily Superintendent Reports | .pdf |
| Detailed Subcontract Status Reports (showing original subcontract value, approved subcontract change orders, subcontractor invoices, payment to subcontractors, etc. | .pdf and Excel |
| Copies of Executed Subcontracts with all Subcontractors | .pdf |
| Copies of all executed change orders issued to Subcontractors | .pdf |
| Copies of all documentation supporting all reimbursable job costs (subcontractor payment applications, vendor invoices, internal cost charges, etc.) | .pdf |

SECTION 01 10 00

SUMMARY OF WORK

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Project, **2024 Cy Ridge HS Renovation**, with campus locations at the following addresses:
- 7900 N. Eldridge Pkwy, Houston, TX 77041
- for the Cypress-Fairbanks Independent School District.
- B. The Project(s) consists of but is not limited to:
Building Additions: Outdoor storage building for athletics, black box, two new art rooms and an auditorium storage.
Architectural Renovations: Flooring, paint, acoustical ceiling, select doors/hardware replacement, restroom accessories, and casework campus wide.
Athletic Field: 2 additional tennis courts and Track recoat.
Replace auditorium controls, HVAC controls, chillers, and boilers.
- C. Project Schedule:
1. Substantial Completion date: July 26, 2026
 2. General phasing requirements refer to Part 3.1.B below.

1.2 CONTRACTS AND USE OF SITE

- A. Contractor Use of Premises:
1. Confine operations at site to areas permitted by law, permits, and Contract Documents, or as required to maintain campus operations (as approved by Owner).
 2. Do not unreasonably encumber site with materials or equipment. Refer to Contractor lay-down areas indicated on plans. If not indicated on plans provided, Contractor to submit for approval proposed Contractor designated areas, including but not limited to: lay-down, staging, parking, restroom, trailer, dumpster, field office, etc.
 3. Assume full responsibility for protection and safekeeping of products stored on premises.
 4. Obtain and pay for use of additional storage or work areas as needed for operations.
 5. Contractor shall establish secured staging area for work and coordinate and provide for safe passage and exit from existing building areas during construction, in compliance with all applicable codes and requirements of Owner.
 6. During phased construction, Contractor shall provide maps of building to Owner for each phase, showing construction area and impact to other areas of the building.
 7. Contractor shall coordinate all construction activities with school district officials.
 8. Owner reserves the right to perform construction operations with its own forces or to employ separate contractors on portions of the Project. General Contractor shall coordinate with Owner-performed work in terms of providing site access, workspace, and storage space, cooperation of work forces, scheduling, and technical requirements.
 9. Noise Control: Contractor shall coordinate equipment locations and timing of work activities so as to avoid conflict with the building occupants and/or avoid interference with facility meetings, events, or other activities.

10. Utilities. The contractor is to coordinate all utilities permanent and temporary and make arrangements for installation for any service easements once the Owner provides information that a blanket or final easement exists.
 11. Project Fencing:
 - a. Upon mobilization, the contractor shall build a wire mesh fence (or other type) as directed by Owner, at least six (6) feet high as shown on site plan and/or discussed during the pre-construction meeting.
 - b. Site fencing shall include emergency service and trucking gated in locations shown on the site plan and/or discussed during the pre-construction meeting.
 - c. Contractor shall properly maintain fencing and gates until Substantial Completion and only remove with concurrence from the Owner.
- B. Owner Occupancy:
1. Refer to AIA Document A201™-2017, as amended.
- C. Owner-Furnished/Owner-Installed Items:
1. The Owner reserves the right to place and install equipment in construction areas of the building prior to Substantial Completion, provided that such occupancy does not interfere with completion of the Work. Such placing of equipment shall not constitute acceptance of the total Work. Contractor shall protect Owner's property.
- D. Owner-Furnished/Contractor-Installed Items:
1. The Owner may provide items to the Contractor for installation in accordance with manufacturer's recommendation and instructions.
 2. The Owner will arrange and pay for delivery of Owner-furnished items in accordance with the Contractor's Construction Schedule and will inspect deliveries for damage.
 3. If Owner-furnished items are damaged, defective or missing, through no fault of the Contractor, the Owner will arrange for replacement.
 4. The Contractor is responsible for designating the delivery dates of Owner-furnished items in the Contractor's Construction Schedule and for receiving, unloading and handling Owner-furnished items at the site. The Contractor is responsible for protecting Owner-furnished items from damage, including damage from exposure to elements, and to repair or replace items damaged as a result of his operations.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Refer to Specification Sections.

PART 3 - EXECUTION

3.1 CONSTRUCTION SCHEDULE

A. GENERAL DESCRIPTION OF WORK TO BE PERFORMED UNDER THIS CONTRACT

The Work to be performed under this contract shall commence on Notice to Proceed and shall be Substantially Complete as stipulated by AIA Document A101™-2017, as amended.

B. GENERAL CONSTRUCTION PHASING REFERENCING CFISD NEEDS BELOW, SHALL BE INCORPORATED INTO THE CONTRACT, INCLUDING BUT NOT LIMITED TO:

For the summer of 2025:

- Contractors may take over the building June 2, 2025.

- All athletic areas are to remain fully occupiable for the duration of the summer. Any work in the athletic areas will need to be coordinated with the campus. For gym work, only one gym can be under construction at any given time.
- All athletic, fine arts, dance, and cafeteria areas must be fully occupiable no later than July 15, 2025.
- The balance of the building shall be fully occupiable and turned back over to the district no later than July 27, 2025.
- Occupiable includes, but is not limited to, all life safety, MEP, architectural finishes in place, clean, and functioning as intended.
- Only work that can be removed and re-installed by these dates shall be performed during the summer.
- No partially complete work will be allowed after these dates unless approved in advance by the Owner.
- After these dates, all work shall be performed after hours, nights and weekends, while fully coordinating with the campus.

For the summer of 2026:

- Contractors may take over the building June 1, 2026.
- All athletic areas are to remain fully occupiable for the duration of the summer. Any work in the athletic areas will need to be coordinated with the campus. For gym work, only one gym can be under construction at any given time.
- All athletic, fine arts, dance, and cafeteria areas must be fully occupiable no later than July 15, 2026.
- The balance of the building shall be **SUBSTANTIALLY COMPLETE**, fully occupiable, and turned back over to the district no later than July 26, 2026.
- Occupiable includes, but is not limited to, all life safety, MEP, architectural finishes in place, clean, and functioning as intended.
- Only work that can be removed and re-installed by these dates shall be performed during the summer.
- No partially complete work will be allowed after these dates unless approved in advance by the Owner.
- After these dates, all work shall be performed after hours, nights and weekends, while fully coordinating with the campus.

Furniture Campus

This campus is receiving new student and administrative furniture via separate contract. However, General Contractor to comply with the following:

General Contractor to coordinate with CFISD and CFISD's vendor to provide interior and exterior clear unobstructed paths and access points for deliveries, product staging, product assembly, setup and disposal.

These areas must be available no later than July 15, 2025 and July 15, 2026 respectively.

- Delivery points will be accessible, clear and drivable by numerous eighteen wheeler trucks over a period of several weeks at middle and high schools.
- Staging/assembly areas include but are not limited to commons cafeteria, gyms, large group instruction, larger hallways (not impeding HCFMO fire egress), etcetera.
- Phased installation may include but not be limited to first setting up administration areas then academic classrooms, and finally ancillary support spaces last possibly spilling over from Summer into Thanksgiving week, Winter Break and Spring Break week if necessary
- As a guide, it is anticipated middle school furniture requires 2-3 weeks and high schools 3-4 weeks for phased installations.

END OF SECTION

SECTION 01 11 23

CODES, REGULATIONS AND STANDARDS

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Quality Assurance
- B. References Standards
- C. Definitions
- D. Format and Specification Context Explanations
- E. Abbreviations
- F. Drawing Symbols
- G. General Requirements

1.2 QUALITY ASSURANCE

- A. General:
 - 1. For products or Workmanship specified by a standard of an association, trade, or Federal standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable code authorities having jurisdiction.
 - 2. The contractual relationship of the parties to the Contract should not be altered from the Contract Documents by mention or inference otherwise in any reference standard.
 - 3. Obtain copies of standards when required by Contract Documents.
 - 4. Maintain copy of standards at jobsite during submittals, planning, and progress of the specific Work for which the standards pertain, until the date of Substantial Completion.
 - 5. In the absence of specific instructions in the specifications, materials, products, equipment and their installation shall conform to the applicable codes, regulations and standards specified therein. When a conflict exists between the applicable code, regulation and standard and that specified, the more stringent code regulation or standard shall prevail, except as authorized by applicable authorities having jurisdiction.
- B. Industry Standards: Where compliance with two (2) or more industry standards or sets of requirements is specified and overlapping of those different standards or requirements establishes different or conflicting minimums or levels of quality, the most stringent requirement is intended and will be enforced, unless specifically detailed language written into the Contract Documents clearly indicates that a less stringent requirement is to be fulfilled. Refer questions to the Architect for a decision before proceeding.
- C. Contractor's Option: Except for overlapping or conflicting requirements, where more than one (1) set of requirements are specified for a particular unit of Work, the option shall be Contractor's regardless of whether or not it is specifically indicated as such.
- D. Minimum Quality/Quantity: In every instance, the quality level or quantity shown or specified is intended to be the minimum for the Work to be performed or provided. Except as otherwise specifically indicated, the actual Work shall either comply exactly with the minimum (within specified tolerances). In complying with requirements, indicated numeric values are either minimums or

maximums as noted or as appropriate for context of requirements. Refer instances of uncertainty to Architect for decision before proceeding.

- E. Specialists; Assignments: In certain instances, specification text requires (or implies) that specific Work is to be assigned to specialists. Such Work shall be accomplished by the specified specialist. These requirements should not be interpreted so as to conflict with applicable regulations, union jurisdiction settlements and similar conventions. Such assignments are intended to establish which party or entity involved in a specific unit of Work is recognized as “expert” for the indicated construction processes or operations. Notwithstanding any such designation, the final responsibility for fulfillment of all Contract requirements remains with the Contractor.

1.3 REFERENCE STANDARDS

- A. Dates of codes, regulations and standards specified shall be the latest date of issue of that code, regulation or standard prior to the date of issue of this Project Manual or Document, except as modified or otherwise directed by the applicable codes and their supplements and amendments adopted by the code authorities having jurisdiction.
 - 1. Date of Issue - The “date of issue” as it appears in the statement above, means the date which appears on the cover of the Project Manual or Document corresponding to the date of issue of the Contract Documents.
 - 2. Code Authorities: The “code authorities” as it appears in the statement above, means the International Building Code (IBC) with City of Houston Amendments, Harris County Regulations, and those authorities responsible for code enforcement.

1.4 DEFINITIONS

- A. General Explanation: A substantial amount of specification language consists of definitions for terms found in other Contract Documents, including those in the AIA A201 General Conditions of the Contract for Construction as amended, Supplementary Conditions, the Drawings, and the Specifications. Drawings must be recognized as being diagrammatic in nature and not completely descriptive of requirements indicated thereon. Certain terms used in the Contract Documents are defined in the General Conditions, Supplementary Conditions, and in this Section. Definitions and explanations contained in this Section are not necessarily either complete or exclusive but are general for this Work to the extent that they are not stated more explicitly in another element of the Contract Documents. In the event of a conflict in definitions or explanations within the Contract Documents or whenever there is need of clarification or interpretation of definitions within or between the Contract Documents, notify the Architect immediately and proceed as directed. Except in cases where definitions are determined by code authorities having jurisdiction, the Architect’s interpretation of all definitions will take precedence.
- B. General Requirements: The provisions or requirements of Division 1 - Sections apply to entire Work of Contract and, where indicated, to other elements which are included in the Project.
- C. Special Conditions: Wherever the term “Special Conditions”, appears in the Contract Documents, it refers collectively to all requirements of the Owner in addition to the sections in Division 1, General Requirements, and to Articles contained in the General Conditions and Supplementary Conditions.
- D. Architect: Wherever the term “Architect” appears in the Contract Documents, it means Page Architects or their authorized representative(s).
- E. Bid, Competitive Sealed Proposal (CSP), Response, Offer, etc.: Wherever the term “Bid”, “Competitive Sealed Proposal (CSP)”, “Response”, “Offer”, “Proposal”, or any derivative thereof, or similar term appears in the Contract Documents, they mean one and the same, and shall mean Competitive Sealed Proposal, which by definition allows the Owner to accept the “best value” for the school district based on factors other than cost in selecting the Contractor.

- F. Contractor, General Contractor, etc.: Wherever the term “Contractor”, “General Contractor”, “Prime Contractor”, “Bidder”, “Bidder/Vendor”, “Vendor”, “Installer”, “Integrator”, “Subcontractor”, “Respondent”, “Offeror”, or any derivative thereof, or similar term appears in the Contract Documents, they mean one and the same, and shall refer to the entity (person or firm) licensed and meeting all applicable regulations of the State of Texas and Department of Labor to perform the Work, or their authorized representative(s).
1. Responsibilities: To avoid any misunderstanding or lack of interpretation, the responsibility for performing the Work is totally that of the entity defined above, and the resolutions proposed in his shop drawings and related documentation shall be demonstrated throughout the Work and specified warranty period.
 2. In the event of a controversy involving the Contract Documents or interpretation of Project requirements, the decision of the Architect will take precedence.
- G. Consultant: Wherever the term “Consultant”, or any derivative thereof appears in the Contract Documents, it means the following:
1. Owner's Consultants:
 - a. Third Party Plan Reviewer: Winning Way
 - b. Materials Testing: Terracon
 - c. Roof Inspection: Raba Kistner
 - d. Mechanical Testing and Balancing: EAB
 - e. Commissioning: EAB
 2. Architect's Consultants:
 - a. Civil Engineer: Brooks & Sparks
 - b. Structural Engineer: Dally & Associates
 - c. MEP Engineer: Salas O'Brien
 - d. Landscape Consultant: n/a
 - e. Roofing Consultant: Raba Kistner
 - f. Food Service Consultant: n/a
 - g. Asbestos Abatement Consultant: EFI Global, Inc.
 - h. Geotechnical Engineer: Terracon
 - i. Traffic Engineer: n/a
 - j. Acoustical Engineer: Salas O'Brien
 - k. Cost Estimating: Halford Busby
- H. Indicated: Wherever the term “indicated”, or any derivative thereof appears in the Contract Documents, it means a cross-reference to graphic representations, notes, or schedules on Drawings, to other paragraphs or schedules in the Specifications, and to similar means of recording requirements in the Contract Documents. Where terms such as “shown”, “noted”, “scheduled”, and “specified” are used in lieu of “indicated”, it is for the purpose of helping reader locate cross-reference, and no limitation of location is intended except as specifically noted.
- I. Directed, Requested, Etc.: Where not otherwise explained, terms such as “directed”, “requested”, “authorized”, “selected”, “approved”, “required”, “accepted”, and “permitted” or any derivative thereof appears in the Contract Documents, it means as “directed by the Architect”, “requested by the Architect”, and similar phrases with actions taken by the Architect. However, no meaning or otherwise shall be interpreted to extend the Architect's responsibility into Contractor's area of construction supervision.
- J. Approve: Wherever the term “Approve”, or any derivative thereof appears in the Contract Documents, it means only the Architect, or an individual designated by him as his representative, can approve or disapprove contract actions. Even if the specifications indicate that an individual other than the Architect, such as the “Engineer” or “Consultant” will approve or disapprove an action, it is understood that only the Architect has this authority unless the individual is so designated by him in writing. Even when an individual is so designated, the Contractor may appeal the action

to the Architect and the Architect's decision will be final. In no case will "approval" by the Architect be interpreted as a release of the Contractor from responsibility to fulfill requirements of the Contract Documents.

- K. **Furnish:** Wherever the term "Furnish", or any derivative thereof appears in the Contract Documents, it means supply or deliver to Project site, ready for unloading, unpacking, assembly, erection, placing, installing, anchoring, applying, curing, finishing, protecting, cleaning and similar operations, as applicable in each instance.
- L. **Install:** Wherever the term "Install", or any derivative thereof appears in the Contract Documents, it means performing the operations at the Project site, of unloading, unpacking, assembly, erection, placing, installing, anchoring, applying, curing, finishing, protecting, cleaning and similar operations, as applicable in each instance.
- M. **Provide:** Wherever the term "Provide", or any derivative thereof appears in the Contract Documents, it means furnish and install at the Project site, complete and ready for intended use, as applicable in each instance.
- N. **Project, Site:** Wherever the term "Project", "Site", or similar such term appears in the Contract Documents, it means the space available to the Contractor for performance of the Work, either exclusively or in conjunction with others performing Work as part of the Project. The extent of project or site is shown on the Drawings and may or may not be identical with description of land upon which Project is to be built.
- O. **District, School District, Owner, etc.:** Wherever the term "District", "School District", "Owner", "Cy-Fair ISD", "CFISD", or similar such term appears in the Contract Documents, it means Cypress-Fairbanks Independent School District, 11430 Perry Road, Houston, Texas 77064, (281) 897-4057, or its authorized representative(s).
- P. **Installer:** Wherever the term "Installer", or any derivative thereof appears in the Contract Documents, it means the entity (person or firm) engaged by the Contractor or its subcontractor or sub-subcontractor for performance of a particular unit of Work at the Project, including installation, erection, application and similar required operations. It is a general requirement that such entities (Installers) be expert in operations they are engaged to perform.
- Q. **Specialist:** Wherever the term "Specialist", or any derivative thereof appears in the Contract Documents, it means an individual or firm of established reputation (or if newly organized, whose personnel have previously established a reputation in the same field), which is regularly engaged in, and which maintains a regular force of Workmen skilled in either (as applicable) manufacturing or fabricating items required by the Contract, installing items required by the Contract, or otherwise performing Work required by the Contract. Where the Contract Specification requires installation by a specialist, that term shall also be deemed to mean either the manufacturer of the item or firm who will perform the Work under the manufacturer's direct supervision.
- R. **Testing Laboratory:** Wherever the term "Testing Laboratory", or any derivative thereof appears in the Contract Documents, it means an independent entity engaged to perform specific inspections or tests of the Work, either at the Project site or elsewhere; and to report and (if required) interpret results of those inspections or tests.

1.5 **FORMAT AND SPECIFICATION CONTEXT EXPLANATIONS**

- A. **Underscoring:** Is used strictly to assist reader of specification text in scanning text for key words (for quick recall). No emphasis on or relative importance is intended where underscoring is used.

- B. Capitalization: Except for manufacturer, product, or trademark names, capitalization is used strictly to assist reader of specification text in scanning text for key words (for quick recall). No emphasis on or relative importance is intended where capitalization is used.
- C. Imperative language: Is used generally in specifications. Except as otherwise indicated, requirements expressed imperatively are to be performed by Contractor. For clarity of reading at certain locations, contrasting subjective language is used to describe responsibilities which must be fulfilled indirectly by the Contractor, or when so noted, by others.
- D. Section Numbering: Is used to facilitate cross-reference in Contract Documents. Sections are placed in Project Manual in numeric sequence; however, numbering sequence is not complete, and listing of sections at beginning of Project Manual must be consulted to determine numbers and names of specification sections in Contract Documents.
- E. Page Numbering: Pages are numbered independently for each section. The section number is shown preceded by the project number and followed by the page number at the bottom of each page, to facilitate the location of text. The project number is given to identify the project, for which specification was written, should the section become separated from the Project Manual.
- F. Specifying Methods: The techniques or methods of specifying to record requirements varies throughout text, and may include “prescriptive”, “open-generic descriptive”, “compliance with standards”, “performance”, or a combination of these. The method used for specifying one unit of Work has no bearing on requirements for another unit of Work.

1.6 ABBREVIATIONS

- A. The language of Specifications and other Contract Documents is of the abbreviated type in certain instances and implies words and meanings which will be appropriately interpreted. Actual Work abbreviations of a self-explanatory nature have been included in texts. Specific abbreviations have been established, principally for lengthy technical terminology and primarily in conjunction with coordination of specification requirements with notations on drawings and in schedules. These are frequently defined in section at first instance of use. Trade association names and titles of general standards are frequently abbreviated. Singular words will be interpreted as plural and plural words will be interpreted as singular where applicable and where full context of the Contract Documents so indicates. A list of typical abbreviations includes but is not limited to the following trade associations and organizations. Refer to Drawings and other Contract Documents for other abbreviations.

| | |
|--------|--|
| AA | Aluminum Association |
| AAMA | Architectural Aluminum Manufacturer's Assn. |
| AASHTO | American Association of State Highway and Transportation Officials |
| ACI | American Concrete Institute |
| ACIL | American Council of Independent Laboratories |
| AGA | American Gas Association |
| AGC | Associated General Contractors of America |
| AHA | American Hardboard Association |
| AHGA | American Hotdip Galvanizers Association |
| AI | Asphalt Institute |
| AIA | American Institute of Architects |
| AISC | American Institute of Steel Construction |
| AISI | American Iron & Steel Institute |
| AITC | American Institute of Timber Construction |
| ANSI | American National Standards Institute |
| APA | American Plywood Association |
| ARI | Air Conditioning & Refrigeration Institute |
| ASA | Acoustical Society of America |
| ASA | American Subcontractors Association |
| ASC | Adhesive & Sealant Council, Inc. |

| | |
|--------|--|
| ASCE | American Society of Civil Engineers |
| ASME | American Society of Mechanical Engineers |
| ASPE | American Society of Professional Engineers |
| ASAHC | American Society of Architectural Hardware Consultants |
| ASHRAE | American Society of Heating, Refrigeration, and Air Conditioning Engineers |
| ASPI | American Wood Preserver's Institute |
| ASTM | ASTM International |
| AWI | Architectural WoodWork Institute |
| AWS | American Welding Society |
| BIA | Brick Institute of America |
| BRI | Building Research Institute |
| CRA | California Redwood Association |
| CLFMI | Chain Link Fence Manufacturers Institute |
| CRSI | Concrete Reinforcing Steel Institute |
| CSI | Construction Specifications Institute |
| DHI | Door and Hardware Institute |
| EPA | Environmental Protection Agency |
| FTI | Facing Tile Institute |
| FGMA | Flat Glass Marketing Association |
| GA | Gypsum Association |
| HPMA | Hardwood Plywood Manufacturers Association |
| IBC | International Building Code |
| ICBO | International Conference of Building Officials |
| IEEE | Institute of Electrical and Electronic Engineers |
| JSMA | Joint Sealer Manufacturers Association |
| MFMA | Maple Flooring Manufacturers Association |
| ML/SFA | Metal Lath/Steel Framing Association |
| NAAMM | National Association of Architectural Metal Manufacturers |
| NAMM | National Association of Mirror Manufacturers |
| NBLP | National Bureau of Lathing & Plastering |
| NCPI | National Clay Pipe Institute |
| NCMA | National Concrete Masonry Association |
| NEMA | National Electrical Manufacturers Assn. |
| NESC | National Environmental Systems Contractors |
| NFPA | National Fire Protection Association |
| NFPA | National Forest Products Association |
| NHLA | National Hardwood Lumber Association |
| NOMMA | National Ornamental Metal Manufacturers Assn |
| NPVLA | National Paint, Varnish and Lacquer Assn. |
| NRMCA | National Ready Mixed Concrete Assn. |
| NRCA | National Roofing Contractors Association |
| NSPE | National Society of Professional Engineers |
| NWMA | National WoodWork Manufacturers Assn., Inc. |
| OSHA | Occupational Safety and Health Administration |
| PDCA | Painting and Decorating Contractors of America |
| PI | Perlite Institute, Inc. |
| PCA | Portland Cement Association |
| RFCI | Resilient Floor Covering Institute |
| RVFC | Rubber and Vinyl Floor Council |
| SBCCI | Southern Building Code Congress International, Inc. |
| SFPA | Southern Forest Products Association |
| SHLMA | Southern Hardwood Lumber Manufacturing Assn. |
| SDI | Steel Deck Institute |
| SDI | Steel Door Institute |
| SJI | Steel Joist Institute |

| | |
|-------|--------------------------------------|
| SSPC | Steel Structures Painting Council |
| TCA | Tile Council of America, Inc. |
| UBC | Uniform Building Code |
| UL | Underwriter's Laboratories, Inc. |
| VBI | Venetian Blind Institute |
| VFI | Vinyl Fabrics Institute |
| WCLIB | West Coast Lumber Inspection Bureau |
| WRCLA | Western Red Cedar Lumber Association |
| WWPA | Western Wood Products Association |

1.7 DRAWING SYMBOLS

- A. General: Except as otherwise indicated, graphic symbols used on drawings are those symbols recognized in the construction industry for purposes indicated. Where not otherwise noted, symbols defined by "Architectural Graphic Standards", published by the American Institute of Architects (AIA) and John Wiley & Sons, Inc., latest edition. Refer instances of uncertainty to Architect for clarification before proceeding.
- B. Mechanical/Electrical Drawings: Graphic symbols used in Mechanical/Electrical Drawings are generally aligned with symbols recommended by American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE). Where appropriate, those symbols are supplemented by more specific symbols as recommended by other recognized technical organizations, including, but not limited to American Society of Mechanical Engineers (ASME), American Society of Professional Engineers (ASPE), Institute of Electrical and Electronic Engineers (IEEE) and similar organizations. Refer instances of uncertainty to Architect for clarification before proceeding.

1.8 GENERAL REQUIREMENTS

- A. Color, Texture, or Pattern Requirements:
1. When color, texture, or pattern is specified, the item, product, or material shall be furnished in the specified color, texture, or pattern, as applicable.
 2. When more than one (1) approved manufacturer is named in the Specifications, Contractor may select any of the approved manufacturers and submit the full range of colors, textures, and patterns (standard and special) available of that manufacturer for the Architect's review and selection.
 3. When the term "match existing", or any derivative thereof appears in the Contract Documents, it means that the sample must match the Owner's existing Work in every respect as to color, texture, and pattern, as applicable.
 4. When the term "match Architect's approved sample", or any derivative thereof appears in the Contract Documents, it means that the Architect has selected a sample which must be matched in every respect as to color, texture, and pattern, as applicable.
 5. When an item or product is specified of a manufacturer for which only one (1) color, texture, or pattern is available, and a color, texture, or pattern other than that one is specified, Contractor shall bring it to the attention of the Architect for a decision prior to proceeding with the Work. Do not proceed with the Work until Architect has approved the color, texture, and pattern, as applicable.
 6. When an item or product is specified of a manufacturer for which no color, texture, or pattern is specified, and colors, textures, and patterns are available, Contractor shall bring it to the attention of the Architect and submit the full range of colors, textures, and patterns (standard and special) available of that manufacturer for the Architect's review and selection. Do not proceed with the Work until Architect has selected and approved the color, texture, and pattern, as applicable.
 7. When due to the nature of the item, product, or material, i.e., face brick, tile pavers, natural stone, etc, Contractor shall submit sample or samples which exhibits the full range of characteristics (colors, i.e. lights and darks, as well as textures, and patterns) for which the item, product, or material is available. The Architect will select the color, texture, and pattern,

- as applicable, from those available and request a sample panel exhibiting the approved characteristics. The approved color range, texture, and pattern, as applicable will then become the standard for which all Work on the project will be judged. Architect will be final judge as to having performed Work in conformance with approved characteristics.
8. Under no circumstances are colors, textures, patterns, or any other characteristics for which an item, product, or material are available to be selected by anyone other than the Architect or Owner.
 9. Non-conforming Work shall be removed from the site and replaced with new conforming Work at no additional expense to Owner.
- B. Continuity of Building Envelope, Full Height Partitions, and Fire Rated Construction:
1. Continuity of Building Envelope:
 - a. All materials such as exterior sheathing, membrane flashings, vapor barriers, insulations, dampproofing, waterproofing, roofing, flashings, etc. and all penetrations, holes, gaps, joints, and openings through such materials shall be sealed to ensure continuity of building envelope, whether indicated or not to eliminate moisture penetration.
 - b. Refer instances of uncertainty to Architect for clarification before proceeding with Work.
 2. Full Height Partitions:
 - a. All full height partitions shall be from floor to bottom of deck structure and shall be made to fit around steel joists, beams, etc., whether indicated or not.
 - b. Seal joints at top of partitions, in flutes of steel deck, and around structural elements with a compressible filler and/or sealant to accommodate movement due to expansion, contraction, and deflection, whether indicated or not. Treat seals in joints of fire rated partitions as specified below for fire rated construction, whether indicated or not.
 - c. Refer instances of uncertainty to Architect for clarification before proceeding with Work.
 3. Fire Rated Construction:
 - a. All seals in fire rated construction, whether at top, bottom, or penetrations through fire rated construction, shall be made with firestopping and firesafing materials to maintain fire rating integrity of construction and satisfy authorities having jurisdiction, whether indicated or not.
 - b. Refer instances of uncertainty to Architect for clarification before proceeding with Work.
- C. Plumbing Line Protection:
1. Placing or washing materials, including, but not limited to the following, down any plumbing line or fixture is strictly forbidden.
 - a. Concrete, cement, sludge, mortar, grout, plaster, or any other cementitious material
 - b. Paint, paint thinner, turpentine, kerosene, gasoline, oil, or any other petroleum or hazardous products.
 2. Cleaning painting equipment, including brushes in new or existing plumbing fixtures is strictly prohibited.
 3. Contractor shall certify that all affected plumbing lines and fixtures are clean, free flowing and running. Plumbing lines and fixtures damaged as a result of any of the above shall be repaired or replaced at no expense to Owner. Contractor shall bear responsibility and all costs of fines, penalties, and legal fees attributed to violations as levied by authorities having jurisdiction.
- D. Support from Structure: Ducts, pipes, conduits, equipment, and other items indicated to be supported from the structure shall be accomplished using approved hangwires, hangers, or devices of type, size and material recommended to suit the application and installed in accordance with recommendations of the hanger or device manufacturer, Architect and/or Structural Engineer, or code authorities having jurisdiction, whichever is the more stringent requirement. Nothing shall be hung from the structure unless directed to do so by the Architect and/or Structural Engineer.

- E. Ducts, Pipes, Conduits, and Wires: Shall be concealed in walls, chases, and enclosed areas out of view, unless specifically indicated as exposed or where exposure is required for proper function of item, such as air registers, air returns, louvers, grilles, vents, thermostats, electrical receptacles, telephone/data terminals and jacks, light switches, etc. Refer instances of uncertainty to Architect for clarification before proceeding.

- F. Fasteners:
 - 1. Unless specifically indicated or directed otherwise, all fasteners in Work exposed to view, shall be concealed in the finished Work.
 - 2. No fasteners shall show through or telegraph through exposed face of finished Work and all finished surfaces shall be free of all evidence of the existence of fasteners.
 - 3. Fasteners shall be spaced to accurately and rigidly secure Work in place.
 - 4. If not shown or otherwise required or recommended by manufacturer, standard, or code authorities having jurisdiction, fastener spacing shall not exceed 12 inches on center.
 - 5. Non-conforming Work shall be removed from the site and replaced with new conforming Work at no additional expense to Owner.

- G. Exposed Metal Work:
 - 1. Unless specifically indicated or directed otherwise, all exposed metal Work shall be flat with all surfaces free of distortions, oil canning, waves, dents, scratches, weld marks, and other surface defects detrimental to good appearance or function.
 - 2. All steel exposed to exterior shall be hot-dip galvanized, phosphate treated for paint retention and shop prime painted.
 - 3. Non-conforming Work shall be removed from the site and replaced with new conforming Work at no additional expense to Owner.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION

SECTION 01 11 26

OWNER/ARCHITECT PROVIDED DOCUMENTS

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 COPIES OF SUPPLEMENTARY CONTRACT DOCUMENTS

- A. The Owner and Architect have included the following Supplementary Contract Documents for the Offerors information. The Owner and Architect **do not** guarantee the accuracy, completeness, or suitability of this information, and the Offerors should verify the existing conditions prior to the Proposal date.
1. Asbestos Survey:
 1. Entitled: Limited Asbestos Survey for Proposed Renovations
 2. Prepared for: Cypress- Fairbanks Independent School District
 3. Prepared by: EFI Global
 4. Dated: December 4, 2024
 2. Geotechnical Report:
 1. Entitled: Geotechnical Report
 2. Prepared for: Page Architects
 3. Prepared by: Terracon Consultants, Inc.
 4. Dated: September 30, 2024
- B. The boring log from the above-mentioned soils report is included in Section 02 32 00, Geotechnical Investigation.
- C. Any of the above documents bound in the drawing or specifications are included for reference purposes only.
- D. Neither Architect nor Owner guarantees their contents as to accuracy, completeness, or suitability.
- E. Copies may be examined at the Architect's office.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION

SECTION 01 21 00

ALLOWANCES

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to the Section.

PART 1 – GENERAL

Refer to Document AB for Substitutions of Materials and Equipment

1.1 CONDITIONS

- A. ALLOWANCES shall be included in the Contract sum as specified within this Specification Section in paragraph 3.1 below. These sums shall be reconciled as per AIA Document A201™–2017, as amended.
- B. Where allowances are for materials only, the cost of delivery to the job site may be funded from such allowance.
- C. Allowances are hereby established for the items in the amounts listed below. If any items exceed the amount listed, such excess cost shall be paid by the Owner. If any items cost less than the amount listed, the Owner shall be given a credit in the amount of the difference. Costs of items listed below are to be net costs to the General Contractor or Subcontractor, whichever makes the direct purchase.
- D. The Contractor shall include in the Contract Sum all allowances stated in the Contract Documents. These allowances shall cover the net cost of the materials and equipment delivered and unloaded at the site, and all applicable taxes.
 - 1. The Contractor's handling costs on site, labor, installation cost, estimating, labor burden, overhead, profit and other expenses contemplated for the original allowances shall be included in the Contractor's Sum and not in the allowance. Subcontractor and sub-subcontractor markups are allowable as provided in AIA Document A201™–2017, as amended.
 - 2. The Contractor shall cause the work covered by these allowances to be performed for such amounts and by such persons as the Architect may direct, but he will not be required to employ persons against whom he makes reasonable objection.
 - 3. The cost, when determined, is more than or less than the allowance, the Contract Sum shall be adjusted accordingly by Change Order which may include additional handling costs on the site, labor, installation costs, overhead, profit, cleaning, as-builts, standard warranty, cost to update electronic record documents and other expenses resulting to the Contractor from any increase over the original allowance if approved.
- E. Contractor shall proceed with the work in question only after receiving written directions executed by the Owner and the Architect. Owner will not be obligated to pay the cost of any work without prior authorization. This written directive shall consist of Owner's representative and Architect's signature on Change Proposal Request document submitted by General Contractor with any applicable amendments if required indicating such approval. The Architect and Owner shall respond in a timely manner to document approved Change Proposal Request (CPR) expenditures and credits from such allowances within the contract. The Contractor may request payment for such approved expenditures only upon completion of the work and the completion of a fully executed CPR formally documenting allowance expenditure credits. The Contractor's overhead and profit relative to these allowance sums and work performed in accordance herewith, shall be included in the total Proposal prices, thus not included in the allowance sum. Unexpended balance of allowance sums shall revert to the Owner by Change Order in the final settlement of the contract.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

3.1 ALLOWANCES

- A. Owner's Betterment Allowance: \$2,673,931.72
1. Contractor shall include the amount indicated above in his Base Proposal as a contingency to cover the cost of additional scope of work. Contractor shall proceed with the work in question only after receiving written directions executed by the Owner and the Architect. Owner will not be obligated to pay the cost of any work performed without prior written authorization. The Contractor's overhead and profit relative to this contingency sum and work performed in accordance herewith, shall be included in the total Base Proposal price, but not included in the contingency sum. Unexpended balance of contingency sums shall revert to the Owner via Change Order during project closeout. Other scopes to be funded from this allowance may include, but are not limited to:

- BMCS Controls
- TDLR Allowance
- Furniture Moving and Relocation
- Emergency Radio Testing
- Promethean Board Moving and Storage
- Video Surveillance Agreement License Upgrade
- Fire Marshall items
- Weight Room Relocation
- Portable Connections
- LVT Moisture Mitigation

END OF SECTION

SECTION 01 22 00

MEASUREMENT AND PAYMENT (UNIT PRICES)

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

Refer to Document AB for Substitutions of Materials and Equipment

1.1 SECTION INCLUDES

- A. Measurement and payment criteria applicable to portions of the Work performed under a unit price payment method.
- B. Defect assessment and non-payment for rejected work.

1.2 AUTHORITY

- A. Measurement methods delineated in the individual specification sections complement the criteria of this Section. In the event of conflict, the requirements of the individual specification section govern.
- B. Take all measurements and compute quantities. The Architect will verify measurements and quantities.

1.3 UNIT QUANTITIES SPECIFIED

- A. Quantities indicated in the Contract Documents are for bidding and contract purposes only. Quantities and measurements supplied or placed in the Work and verified by the Architect determine payment.
- B. If the actual Work requires more or fewer quantities than those quantities indicated, provide the required quantities at the unit sum/prices contracted.

1.4 MEASUREMENT OF QUANTITIES

- A. Measurement Devices:
 - 1. Weigh Scales: Inspected, tested, and certified by the applicable State Weights and Measures Department within the past year.
 - 2. Platform Scales: Of sufficient size and capacity to accommodate the conveying vehicle.
 - 3. Metering Devices: Inspected, tested, and certified by the applicable State department within the past year.
- B. Measurement by Weight: Concrete reinforcing steel, rolled or formed steel or other metal shapes will be measured by handbook weights. Welded assemblies will be measured by handbook or scale weight.
- C. Measurement by Volume: Measured by cubic dimension using mean length, width and height or thickness.
- D. Measurement by Area: Measured by square dimension using mean length and width or radius.
- E. Linear Measurement: Measured by linear dimension, at the item centerline or mean chord.
- F. Stipulated Sum/Price Measurement: Items measured by weight, volume, area, or linear means or combination, as appropriate, as a completed item or unit of the Work.

1.5 PAYMENT

- A. Payment Includes: Full compensation for all required labor, labor burden, products, tools, equipment, plant, transportation, services and incidentals; erection, application or installation of an item of the Work; overhead and profit.
- B. Final payment for Work governed by unit prices will be made on the basis of the actual measurements and quantities confirmed and accepted by the Architect multiplied by the unit/sum price for work which is incorporated in or made necessary by the Work.

1.6 DEFECT ASSESSMENT

- A. Replace the Work, or portions of the Work, not conforming to specified requirements.
- B. The individual specification sections may modify these options or may identify a specific formula or percentage sum/price reduction.
- C. The authority of the Architect to assess the defect and identify payment adjustment is final.

1.7 NON-PAYMENT FOR REJECTED PRODUCTS

- A. Payment will not be made for any:
 - 1. Products wasted or disposed of in a manner that is not acceptable.
 - 2. Products determined as unacceptable before or after placement.
 - 3. Products not completely unloaded from the transporting vehicle.
 - 4. Products placed beyond the lines and levels of the required work.
 - 5. Products remaining on hand after completion of the work.
 - 6. Loading, hauling and disposing of rejected Products.

PART 2 – DESCRIPTION OF UNIT PRICES

2.1 GENERAL

- A. For the work described unit pricing shall be used to determine the additional cost or credit to the contract amount or added to or deducted from the Owner’s contingency for changes in the scope of work made during the progress of the work as directed by Architect.
- B. The same price shall be used for adding or deducting from the scope of work. No exceptions.
- C. The following unit prices shall be included in the proposal form and shall be included in the Owner-Contractor agreement.

PART 3 - EXECUTION

3.1 SCHEDULE OF UNIT PRICES

- A. Unit Prices shall be used, where applicable, to make adjustments to the cost of the work due to changes. All Unit Prices submitted shall be complete “turnkey” prices for fully functioning systems, and shall include all costs for overhead, profit, labor, labor burden, material, equipment, and any other incidentals related to the completion of the Work and shall remain firm for the duration of the contract. Unit prices listed are for additive and/or deductive work.

UNIT PRICE 1: ELECTRICAL DUPLEX RECEPTACLE

Provide unit price for a new 20A, 120V duplex electrical receptacle and cover plate, flush mounted in a CMU, metal stud, or demountable wall construction, circuited to an existing electrical panel within 150 feet of the outlet using a branch circuit consisting of 2 #10 AWG and 1 #10 AWG ground in 3/4-inch EMT conduit. All conduits to be concealed in wall construction. Unit price shall include a 20-amp circuit breaker to be installed in existing panel space.

UNIT PRICE 2: DATA DROP

Provide unit price for a data drop, flush mounted in a CMU, metal stud or demountable wall construction., wired to an IDF/MDF Room. The data drop shall consist of a single gang wall box, cabling wiring device, cover plate, 3/4-inch conduit from outlet to above accessible ceiling, plenum-rated cabling routed above accessible ceiling to the nearest MDF or IDF location within 250 feet of the outlet. Termination and testing to be included in the unit price.

UNIT PRICE 3: 4 ½” THICK CONCRETE WALK PER SQUARE FOOT

This unit cost shall establish the amount to the contract price for the Contractor to add or deduct 4 ½” thick concrete walk (minimum 100 SF) per Square Foot.

UNIT PRICE 4: 7” THICK CONCRETE DRIVE PER SQUARE FOOT

This unit cost shall establish the amount to the contract price for the Contractor to add or deduct 7” thick concrete drive (minimum 100 SF) per Square Foot.

UNIT PRICE 5: CONCRETE SLAB PER SQUARE FOOT

This unit cost shall establish the amount to the contract price for the Contractor to add or deduct 7” thick concrete drive (minimum 100 SF) per Square Foot.

UNIT PRICE 6: DEMO CONCRETE SLAB PER SQUARE FOOT

This unit cost shall establish the amount to the contract price for the Contractor to add or deduct 7” thick concrete drive (minimum 100 SF) per Square Foot.

UNIT PRICE 7: LIFE SAFETY DEVICES (including all associated cabling and programming)

This unit cost shall establish the amount to be added or deducted from the contract price for the Contractor to add /deduct Fire Alarm devices.

| | | | |
|----|--------------------------------|----------|------|
| 1. | Exterior Horn to Speaker | \$ _____ | each |
| 2. | Interior Horn to Speaker | \$ _____ | each |
| 3. | Interior Visual Strobe | \$ _____ | each |
| 4. | Interior Speaker/Visual Strobe | \$ _____ | each |
| 5. | Smoke Detector | \$ _____ | each |
| 6. | Heat Detector | \$ _____ | each |
| 7. | Manual Pull Station | \$ _____ | each |
| 8. | Stopper 2 Pull Station Cover | \$ _____ | each |
| 9. | Annunciator Panel | \$ _____ | each |
| 10 | Duct Detector | \$ _____ | each |
| 11 | Relay | \$ _____ | each |
| 12 | Supervisory | \$ _____ | each |
| 13 | Waterflow | \$ _____ | each |
| 14 | Amplifier | \$ _____ | each |

15 Remote Power Supply \$_____ each

UNIT PRICE 8: GRAPHIC SIGNS

This unit cost shall establish the amount to be added or deducted to the contract price for the Contractor to remove existing signage and install new as described below:

- 1. Sign Type A \$_____/ each
- 2. Sign Type B \$_____/ each
- 3. Sign Type C \$_____/ each
- 4. Sign Type D \$_____/ each
- 5. Sign Type E \$_____/ each
- 6. Sign Type F \$_____/ each
- 7. Max Occupancy Signage \$_____/ each
- 8. FDC Connection Signage \$_____/ each
- 9. Wayfinding Signage (2 lines text) \$_____/ each
- 10. Wayfinding Signage (3 lines text) \$_____/ each
- 11. Wayfinding Signage (4 lines text) \$_____/ each

UNIT PRICE 9: PAINTING

This unit cost shall establish the amount to be added or deducted to the contract price for the Contractor to paint 100 square feet of wall (minimum 400 square feet of wall).

UNIT PRICE 10: ASBESTOS ABATEMENT COMPONENTS

This unit cost shall establish the amount to be added or deducted to the contract price for the Contractor to add/deduct asbestos abatement components as described below:

| No. | Unit Price Description | Add(\$/Figures) | Unit of Measure |
|-----|--|-----------------|--------------------------|
| | ASB-1 Price per unit for the proper removal, transportation, and disposal of interior ACBM Mirror Mastic. All work to be Completed in compliance with AHERA and TAHPR regulations. (Full Containment) | _____ | Individual Mirror |

UNIT PRICE 11: EXIT SIGN

This unit cost shall establish the amount to be added to the contract price to provide and install one (1) exit sign. Price shall include wiring to nearest available emergency circuit, up to 200 feet.

UNIT PRICE 12: ORNAMENTAL FENCE

This unit cost shall establish the amount to be added or deducted from the contract price for the Contractor to add/deduct ornamental fence.

- | | | | |
|----|--------------------------------|------------|-------------|
| 1. | 6-foot-high fence | \$ _____ / | linear foot |
| 2. | 6-foot-high x 4-foot-wide gate | \$ _____ / | per leaf |
| 3. | 6-foot-high x 6-foot-wide gate | \$ _____ / | per leaf |

UNIT PRICE 13: SECURITY FILM

This unit cost shall establish the amount to be added to the contract price to provide and install security film on existing exterior glazing (minimum 200 square feet).

- | | | | |
|----|--------------|------------|-------------|
| 1. | Armoured One | \$ _____ / | Square foot |
|----|--------------|------------|-------------|

END OF SECTION

SECTION 01 23 00

ALTERNATES

PART 1 - GENERAL

1.1 ALTERNATE PRICES

- A. Contractor shall state, in the spaces provided in the proposal form, Alternate Prices for the work described below. The responsibility of determining quantity of Alternates rests with the Contractor. Base Proposal and Alternates shall include cost of all supporting elements required, so that no matter what combination of Base Proposal and Alternates are accepted, that portion shall be a complete entity. Work for all Alternates shall be in strict accordance with the specification sections noted and applicable to the specific work.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

3.1 ALTERNATES

- A. **Alternate Number 1: Base Bid Adjustment**
This alternate shall establish the adjustments to the General Contractor's Base Proposal submitted at 2:00 pm, if necessary. This alternate shall be accepted whether it is an add or a deduct and will be used as part of the evaluation process to determine the best value for the District.
- B. **Alternate Number 2A: Chillers by Carrier**
This alternate shall establish the amount to be added to the base proposal for the Contractor to furnish and install Water Cooled Centrifugal chillers with VFD as manufactured by Carrier as shown on the drawings and listed in the specifications. There are no chillers included in the base proposal.
- C. **Alternate Number 2B: Chillers by Daikin**
This alternate shall establish the amount to be added to the base proposal for the Contractor to furnish and install Water Cooled Centrifugal chillers with VFD as manufactured by Daikin as shown on the drawings and listed in the specifications. There are no chillers included in the base proposal.
- D. **Alternate Number 2C: Chillers by Daikin**
This alternate shall establish the amount to be added to the base proposal for the Contractor to furnish and install Water Cooled Magnetic Bearing Centrifugal chillers with VFD as manufactured by Daikin as shown on the drawings and listed in the specifications. There are no chillers included in the base proposal.
- E. **Alternate Number 2D: Chillers by Trane**
This alternate shall establish the amount to be added to the base proposal for the Contractor to furnish and install Water Cooled Centrifugal chillers with CFD as manufactured by Trane as shown on the drawings and listed in the specifications. There are no chillers included in the base proposal.
- F. **Alternate Number 3A: Two Cell Counterflow Cooling Tower by Evapco**
This alternate shall establish the amount to be added to the base proposal for the Contractor to provide HVAC Two Cell Counterflow Cooling tower furnished and installed as manufactured by Evapco as shown on the drawings and listed in the specifications. This alternate shall include the costs associated with the installation of the Evapco Two Cell Cooling tower, the structural supports,

make-up water piping exterior of the building, condenser water piping exterior of the building, electrical and conduits. There are no HVAC Two Cell cooling towers, structural supports, make-up water piping exterior of the building, condenser water piping exterior of the building, electrical and conduits included in the base bid.

G. **Alternate Number 3B: Three Cell Counterflow Cooling Tower by Evapco**

This alternate shall establish the amount to be added to the base proposal for the Contractor to provide HVAC Three Cell Counterflow Cooling towers furnished and installed as manufactured by Evapco as shown on the drawings and listed in the specifications. This alternate shall include the costs associated with the installation of the Three Cell Evapco cooling tower, the structural supports, make-up water piping exterior of the building, condenser water piping exterior of the building, electrical and conduits. There are no HVAC Three Cell cooling towers, structural supports, make-up water piping exterior of the building, condenser water piping exterior of the building, electrical and conduits included in the base bid.

H. **Alternate Number 3C: Three Cell Counterflow Cooling Tower by Marley**

This alternate shall establish the amount to be added to the base proposal for the Contractor to provide HVAC Three Cell Cooling towers furnished and installed as manufactured by Marley as shown on the drawings and listed in the specifications. This alternate shall include the costs associated with the installation of the Marley Three Cell cooling tower, the structural supports, make-up water piping exterior of the building, condenser water piping exterior of the building, electrical and conduits. There are no HVAC Three Cell cooling towers, structural supports, make-up water piping exterior of the building, condenser water piping exterior of the building, electrical and conduits included in the base bid.

3.2 GENERAL NOTES

- A. Unless otherwise indicated, scope of work for each alternate shall include material and labor, general conditions and all other costs associated with completing the work described.
- B. Alternates are not listed in any order of priority.
- C. Acceptance of alternates shall be the sole discretion of the Owner.
- D. See Section AB for alternate pricing timelines.

END OF SECTION

SECTION 01 29 73

SCHEDULE OF VALUES

CONDITIONS OF THE CONTRACT and DIVISION 1, as indexed, apply to this Section.

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Refer to Instructions to Proposers for substitutions.
- B. 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.

1.2 QUALITY ASSURANCE

- A. Use required means to assure arithmetical accuracy of the sums described. All calculations shall be to two (2) decimal places.
- B. When so required by the Owner, provide copies of the subcontracts or other data acceptable to the Owner, substantiating the sums described.

1.3 SUBMITTALS

- A. Prior to the first Application for Payment, submit a proposed Schedule of Values to the Owner and Architect as outlined below:
 - 1. Meet with the Owner and Architect 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.

1.4 SCHEDULE OF VALUES

- A. The Schedule of Values shall be broken down into item costs for each specification section as a minimum with materials and labor separated. After review by the Owner and Architect, the Schedule of Values shall be broken down into further items as required. (See following list).
- B. Schedule of Values: Refer to the following sample.
- C. Indicate page subtotals on each page of Schedule of Values.
- D. Each page to be printed single-sided.
- E. Schedule of Values is to be submitted for approval per AIA Document A101, Article 3.3

PART 2 – PRODUCTS

Not Used

PART 3 - EXECUTION

3.1 SCHEDULE OF VALUES

- A. Refer to sample attached herein.

**SECTION 01 29 73
 SCHEDULE OF VALUES - SAMPLE**

| Item No. | Description of Work | Scheduled Value | Work Completed | | Stored Matls | Total Completed | % | | | | | | |
|----------|--|-----------------|----------------|-----------|--------------|-----------------|---|--|--|--|--|--|--|
| | | | Previous App. | This App. | | | | | | | | | |
| | <p><i>NOTE: IF PROJECT CONSISTS OF BOTH NEW ADDITION(S) AND REMODEL (S), EACH SHALL HAVE A SEPARATE SCHEDULE OF VALUES. Listing shall include but not be limited to:</i></p> <p>Div. 1 - General Conditions Sitework Supervision Mobilization Contractor's Fee General Conditions Temp. Facilities Project sign Coordination drawings Final Cleaning As-Builts/Close-out/O&M Manuals/Record Drawings Permits Bonds Insurance Contractor's written Punch List</p> <p>Div. 2 - Existing Conditions</p> <p>Div. 3 - Concrete Drilled Piers Matls Drilled Piers Labor Caps & Beams Matls Caps & Beams Labor Slab on Grade Matls Slab on Grade Labor Cooling Tower Basin Matls Cooling Tower Basin Labor Misc. Bldg Concrete Matls Misc. Bldg Concrete Labor Rebar Matls Rebar Labor Lt. Wt. Insul Fill - Matls Lt. Wt. Insul Fill - Labor Close-out Documents Punch List</p> | | | | | | | | | | | | |

Div. 4 - Masonry

Brickwork - Matls
Brickwork - Labor
Concrete Masonry - Matls
Concrete Masonry - Labor
Str. Glazed Tile - Labor
Str. Glazed Tile - Matls
Masonry clean up/acid wash
Close-out Documents
Punch List

Div. 5- Metals

Structural Steel - Matls
Structural Steel - Labor
Misc. Steel - Matls

Steel Joists - Matls

Lt. Gauge Steel Framing - Matls
Lt. Gauge Steel Framing - Labor
Metal Decking - Matls
Metal Decking - Labor
Expansion Covers - Matls
Expansion Covers - Labor
Alternating Stairs Matls
Alternating Stairs Labor
Close-out Documents
Punch List

Div. 6 - Wood & Plastics

Rough Carpentry - Matls
Rough Carpentry - Labor
Millwork - Matls
Millwork - Labor

Div. 7 - Thermal & Moisture Protection

Waterproofing & Dampproofing Matls
Waterproofing & Dampproofing Labor
Building Insulation - Matls
Building Insulation - Labor
Fireproofing - Matls
Fireproofing - Labor
Metal Roof - Matls
Metal Roof - Labor
Metal Roof Guarantee
Modified Bitumen Roofing Base Sheet- Matls
Modified Bitumen Roofing Base Sheet - Labor
Modified Bitumen Roofing Cap Sheet - Matls

Modified Bitumen Roofing Cap Sheet - Labor
Modified Bitumen Roofing - Guarantee
Building Sheet Metal - Matls
Building Sheet Metal - Labor
Bldg. Sheet Metal Guarantee
Roof Curbs Matls
Roof Curbs Labor
Roof Hatches Matls
Roof Hatches Labor
Sealants Matls
Sealants Labor
Roof Accessories Matls
Roof Accessories Labor
Close-out Documents
Punch List

Div. 8 - Doors & Windows

Finish Carpentry/Door - Matls
Finish Carpentry/Door - Labor
Finish Hardware - Matls
Finish Hardware - Labor
Thresholds & Seals Matls
Thresholds & Seals Labor
Hollow Metal Doors & Frames - Matls
Hollow Metal Doors & Frames - Labor
Plastic Faced Doors - Matls
Plastic Faced Doors - Labor
Overhead Doors & Grilles - Matls
Overhead Doors & Grilles - Labor
Alum. Entrances & Storefronts - Matls
Alum. Entrances & Storefronts - Labor
Alum. Windows - Matls
Alum. Windows - Labor
Glass & Glazing - Matls
Glass & Glazing - Labor
Glass & Glazing - water test
Close-out Documents
Punch List

Div. 9 - Finishes

Lath & Plaster - Matls
Lath & Plaster - Labor
Gypsum Wallboard Systems - Matls
Gypsum Wallboard Systems - Labor
Ceramic Tile - Matls
Ceramic Tile - Labor
Quarry Tile - Matls
Quarry Tile - Labor
Terrazzo - Matls

| | | | | | |
|-------------------------------------|--|--|--|--|--|
| Terrazzo - Labor | | | | | |
| Acoustic Clg. - Matls | | | | | |
| Acoustic Clg. - Labor | | | | | |
| Acoustic Wall Panels - Matls | | | | | |
| Acoustic Wall Panels - Labor | | | | | |
| Resilient Flooring - Matls | | | | | |
| Resilient Flooring - Labor | | | | | |
| Carpet - Matls | | | | | |
| Carpet - Labor | | | | | |
| Athletic Flooring - Matls | | | | | |
| Athletic Flooring Labor | | | | | |
| Floor Sealer - Matls | | | | | |
| Floor Sealer - Labor | | | | | |
| Painting - Matls | | | | | |
| Paint - Labor | | | | | |
| Close-out Documents | | | | | |
| Punch List | | | | | |
| Div. 10 - Specialties | | | | | |
| Tackboards - Matls | | | | | |
| Tackboards - Labor | | | | | |
| Toilet Partitions - Matls | | | | | |
| Toilet Partitions - Labor | | | | | |
| Louvers - Matls | | | | | |
| Louvers - Labor | | | | | |
| Aluminum Flag Pole - Matls | | | | | |
| Aluminum Flag Pole - Labor | | | | | |
| Graphics -Matls | | | | | |
| Graphics -Labor | | | | | |
| Lockers Matls | | | | | |
| Lockers Labor | | | | | |
| Locker combinations in Excel format | | | | | |
| Demountable Partitions - Matls | | | | | |
| Demountable Partitions - Labor | | | | | |
| Metal Shelving Matls | | | | | |
| Metal Shelving Labor | | | | | |
| Scoreboards - Matls. | | | | | |
| Scoreboards - Labor | | | | | |
| Toilet Room Accessories - Matls | | | | | |
| Toilet Room Accessories - Labor | | | | | |
| Visual Display Boards - Matls | | | | | |
| Visual Display Boards - Labor | | | | | |
| Cubicle Curtains & Track - Matls | | | | | |
| Cubicle Curtains & Track - Labor | | | | | |
| Fire Extinguisher Cabinets Matls | | | | | |
| Fire Extinguisher Cabinets Labor | | | | | |
| Close-out Documents | | | | | |
| Punch List | | | | | |

Div. 11 - Equipment

Stage Curtains Matls
Stage Curtains Labor
Stage rigging Matls
Stage rigging Labor
Stage lighting Matls
Stage lighting Labor
Misc. Appliances Matls
Misc. Appliances Labor
Food Service - Submittals/coordination drawings
Food Service - Walk-ins Matls
Food Service - Walk-ins Labor
Food Service - Flatwork - Matls
Food Service - Flatwork - Labor
Food Service Eqpt - Labor
Food Service Eqpt - Matls
Food Service - Close-out Documents
Food Service - Training
Food Service - Kitchen Hoods - Matls
Food Service - Kitchen Hoods - Labor
Food Service - Ansul Syst. - Matls
Food Service - Ansul Syst. - Labor
Close-out Documents
Punch List

Div. 12 - Furnishings

Casework - Matls
Casework - Labor
Science Casework - Matls
Science Casework - Labor
Horizontal Blinds - Matls
Horizontal Blinds - Labor
Projection Screen - Matls
Projection Screen - Labor
Close-out Documents
Punch List

Div. 13 - Special Construction

Div. 14 - Conveying Systems

Elevator - Matls
Elevator - Labor
Elevator - Maintenance Agreement

Div. 21 - Fire Suppression

Fire Sprinkler Syst. - Eng/Submittals
Fire Sprinkler Syst. - Underground piping/Vault -
Matls
Fire Sprinkler Syst. - Underground piping/Vault -

Labor
Fire Sprinkler Syst. - Above slab piping - Matls
Fire Sprinkler Syst. - Above slab piping - Labor
Fire Sprinkler Syst. - Trim-out - Matls
Fire Sprinkler Syst. - Trim-out - Labor
Fire Sprinkler Syst. - Start-up/Testing
Fire Sprinkler Syst. - Close-out Documents
Close-out Documents
Punch List

Div. 22 - Plumbing

Shop Drawings
Coordination Drawings
As-Builts/Close-out O&M Manuals
Sanitary Underground - Matls
Sanitary Underground - Labor
Storm Underground - Matls
Storm Underground - Labor
Domestic Water - Matls
Domestic Water - Labor
Plumbing Dissolution Matls
Plumbing Dissolution Labor
Gas Piping - Matls
Gas Piping - Labor
Grease Trap - Matls
Grease Trap - Labor
Fixtures - Matls
Fixtures - Labor
Rodding/Camera lines

**Div. 23 - Heating Ventilating and Air
Conditioning**

Shop Drawings
As-Builts/Close-out O&M Manuals
Coordination drawings
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 - Matls | | | | | |
| Pumps - Labor | | | | | |
| Water Treatment - Matls | | | | | |
| Water Treatment - Labor | | | | | |
| Isolation - Matls | | | | | |
| Isolation - Labor | | | | | |
| Pipe Flex - Matls | | | | | |
| Pipe Flex - Labor | | | | | |
| Sheet Metal - Matls | | | | | |
| Sheet Metal - Labor | | | | | |
| Duct Insulation - Matls | | | | | |
| Duct Insulation - Labor | | | | | |
| Pipe Insulation - Matls | | | | | |
| Pipe Insulation - Labor | | | | | |
| Pipe, Valves, Fittings - Matls | | | | | |
| Pipe, Valves, Fittings - Labor | | | | | |
| Misc. - Labor | | | | | |
| Misc. - Matls | | | | | |
| Insulation - Matls | | | | | |
| Insulation - Labor | | | | | |
| Sanitary Above Slab - Matls | | | | | |
| Sanitary Above Slab - Labor | | | | | |
| Storm Above Slab - Labor | | | | | |
| Storm Above Slab - Matls | | | | | |
| Gas - Matls | | | | | |
| Gas - Labor | | | | | |
| Fixtures - Matls | | | | | |
| Fixtures - Labor | | | | | |
| Permits | | | | | |
| VAV Boxes - Matls | | | | | |
| VAV Boxes - Labor | | | | | |
| Refrigerant Monitor - Matls | | | | | |
| Refrigerant Monitor - Labor | | | | | |
| Unit Heaters - Matls | | | | | |
| Unit Heaters - Labor | | | | | |
| Startup | | | | | |
| Controls | | | | | |
| Eng/Submittals | | | | | |
| Valves/Dampers - Matls | | | | | |
| Valves/Dampers - Labor | | | | | |
| Box Controls - Matls | | | | | |
| Box Controls - Labor | | | | | |
| Modules -Matls | | | | | |
| Modules -Labor | | | | | |
| End Devices - Matls | | | | | |
| End Devices - Labor | | | | | |
| Low Voltage Wiring - Matls | | | | | |
| Low Voltage Wiring - Labor | | | | | |

Startup/commissioning
Software Installation/Graphics upload to CFISD
server
Close-out Documents
Training
Punch List

Div. 26 - Electrical

Mobilization
Shop Drawings
As-Builts/Close-out/O&M Manuals
Underground - Matls
Underground - Labor
Conduit -Matls
Conduit - Labor
Wire - Matls
Wire - Labor
Feeder Wire - Matls
Feeder Wire -Labor
Switches/Recpt. Matls
Switches/Recpt. Labor
Switchgear - Matls
Switchgear - Labor
Temporary - Matls
Temporary - Labor
Gas Generator - Matls
Gas Generator - Labor
Fixtures - Matls
Fixtures - Labor
Low Voltage - Engineering/Submittals
Low Voltage Lighting- Devices - Matls
Low Voltage Lighting- Devices - Labor
Low Voltage Lighting - Wiring - Matls
Low Voltage Lighting - Wiring - Labor
Low Voltage Lighting - Programming/Start-up
Low Voltage Lighting- Training
Low Voltage Lighting - Close-out Documents
Voice System - Wiring - Matls
Voice System - Wiring - Labor
Video System - Trim-out - Matls
Video System - Trim-out - Labor
Video System - Testing
Master Clock - Matls
Master Clock - Labor
Close-out Documents
Punch List
Coordination Drawings

Div. 27 - Communications

Data System - Matls
Data System - Labor
Data System - Testing
Communications/PA - Control Panels - Matls
Communications/PA - Control Panels - Labor

Div. 28 - Electronic Safety and Security

Fire Alarm - Control Panel - Labor
Fire Alarm - Wiring - Matls
Fire Alarm - Wiring - Labor
Fire Alarm - Devices - Matls
Fire Alarm - Devices - Labor
Fire Alarm - Testing
Fire Alarm - Training
Fire Alarm - Close-out Documents
Security Systems - Submittals
Security Systems - Devices - Matls
Security Systems - Devices - Labor
Security Systems - Wiring - Matls
Security Systems - Wiring - Labor
Security Systems - Cameras Matls
Security Systems - Cameras Labor
Security Systems - DVR Equipment - Matls
Security Systems - DVR Equipment - Labor
Security Systems - Programming/Start-up
Security Systems - Training
Security Systems - Close-out Docs.
Video System - Close-out Docs

Div. 31 - Earthwork

Detention pond Final County inspection permit document
Demolition (as applicable)
Site Clearing & Grubbing
Earthwork - Matls
Earthwork - Labor
Finish Grading Matls
Finish Grading Labor
Stabilization Matls
Stabilization Labor
Site Drainage - Matls
Site Drainage - Labor

Div. 32 - Exterior Improvements

Chain Link Fence - Matls
Chain Link Fence - Labor
Paving - Matls
Paving - Labor
Sidewalks - Matls

| | | | | | | |
|--|--|--|--|--|--|--|
| | Sidewalks - Labor Erosion Control - Matls Erosion Control - Labor Building Pad - Matls Building Pad - Labor Paving Subgrade Signage/Striping Bike Racks Landscaping - Matls Landscaping - Labor Sod - Matls Sod - Labor Hydromulch - Matls Hydromulch - Labor Irrigation - Matls Irrigation - Labor Irrigation system testing/demonstration Div. 33 - Utilities Site Storm - Matls Site Storm - Labor Site Sanitary - Matls Site Sanitary - Labor U/G Fire Line - Matls U/G Fire Line - Labor Site Lighting - Matls Site Lighting - Labor Close-out Documents Punch List Alternates 1 2 3 4 5 Allowances: A. Owner's Betterment Allowance | | | | | |
|--|--|--|--|--|--|--|

General Note: Close-out lists shall include As-builts, O&M's, Demonstration/Training, and any attic owner's stock.

END OF SECTION

SECTION 01 31 13

PROJECT COORDINATION

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 REQUIREMENTS

- A. General: notify the Architect whenever there is need of clarification or interpretation of the Contract Documents prior to commencement of work.
- B. Commencement of work without Architect's prior notification means Contractor's acceptance of responsibility.
- C. Commencement of work without Architect's prior notification implies Contractor's understanding of conditions, assemblies, methods, or procedures.
- D. The project superintendent shall notify the Owner on an ongoing basis of ongoing work.

1.2 PRE-INSTALLATION CONFERENCE

- A. General: Notify the Architect 48 hours in advance of certain stages of construction, and, as required by the Architect, organize a pre-installation meeting with each trade individually prior to commencement of their portion of the Work. At a minimum, representatives of the Architect, the General Contractor's project superintendent, and the Sub-contractor's Foreman and Project Manager shall be present at each meeting. The Engineer shall be notified as applicable.
- B. As indicated in each specific section of this Project Manual, or as required by the Architect, these stages generally include, but are not necessarily limited to the following:
 - 1. Division 2 - (Selective) Demolition.
 - 2. 05 50 00 - Miscellaneous metals, ladders, brackets, pipe rails, etc.
 - 3. Division 6 - Finish Carpentry and Millwork
 - 4. Division 7 - installation of waterproofing, vapor barriers, flashing and sheet metal.
 - 5. Division 7 - Installation of roofing system(s) and associated work.
 - 6. 07 21 00 - Concealment of insulation.
 - 7. Division 8 - Installation of doors, frames, windows, and storefronts.
 - 8. 08 71 00 - Installation of finish hardware
 - 9. Division 9 - Installation of plaster and gypsum board products.
 - 10. Division 9 - Installation of tile, flooring, and pavers.
 - 11. 09 51 00 - Installation of acoustical ceiling (grid and panels).
 - 12. 09 65 19 - Installation of resilient flooring and base.
 - 13. 09 91 00 - Painting and staining (each coat).
 - 14. Divisions 22, 23 and 26 - Completion of roughing-in of plumbing, heating, air conditioning and electrical work (prior to concealment).
 - 15. Division 23 - Installation of heating, ventilating and air conditioning.
 - 16. Division 26 - Installation of all electrical fixtures.
 - 17. Divisions 22, 23 and 26 - Any and all testing specified for equipment, mechanical, electrical and plumbing systems.
 - 18. 31 00 00 - Clearing and stripping of top soil within limits of grading.
 - 19. 31 00 00 - (Excavation and) Placing (of each lift of) select fill material, and site grading.
 - 20. 31 00 00, 31 23 23.13, and Divisions 22, 23 and 26 - Compaction, inspection, testing, and covering of underground utilities.
 - 21. Division 32 - Installation of site amenities, fencing, surfaces, landscaping, etc.

- C. In addition to notifying the Architect, notify the Structural Engineer (48 hours) prior to the following stages:
 - 1. Drilling, reinforcing, and placing of first piers and footings.
 - 2. Placing first reinforcing and grade beams.
 - 3. Erecting structural steel elements.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

3.1 PRE-CONSTRUCTION CONFERENCE

- A. The Contractor shall contact Architect at least ten (10) days prior to commencing construction in order for Architect to schedule a pre-construction meeting with Contractor, Architect, and Owner. This meeting must occur prior to commencement of any construction.

3.2 CONFERENCES AND MEETINGS

- A. Refer to Section 01 31 19, Project Meetings for requirements pertaining to Pre-construction Conference, Progress Meetings, and Pre-installation Conferences.

END OF SECTION

SECTION 01 31 19

PROJECT MEETINGS

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 REQUIREMENTS INCLUDE

- A. The Architect will:
 - 1. Schedule each meeting (pre-construction conference, periodic project meetings, pre-installation meetings, and specially called meetings throughout the progress of the work).
 - 2. Prepare agenda for meetings.
 - 3. Preside at meetings, including all significant proceedings and decisions.
 - 4. record, reproduce, and distribute copies of meeting minutes within seven (7) days, excluding weekends and holidays, after each meeting to:
 - a. All participants in the meeting.
 - b. All parties affected by decisions made at the meeting.

- B. The Contractor shall:
 - 1. Make physical arrangement for meetings.
 - 2. Participate in all meetings and conferences.
 - 3. Schedule attendance of Job Superintendent, Project Manager, and other parties affecting or affected by decisions made at meetings and conferences as their interests require.
 - 4. Provide updated schedules.
 - 5. Provide status reports/logs of RFIs, CPRs, MCs, and shop drawings/submittals.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

3.1 PRE-CONSTRUCTION CONFERENCE

- A. Architect will:
 - 1. administer pre-construction conference for the establishment of communication methods, procedures and Owner requirements.
 - 2. administer site mobilization conference for clarification of Owner and Contractor.

- B. Location: At Project site or as designated by the Architect.

- C. Attendance:
 - 1. Contractor or Contractor's Representative
 - 2. Job Superintendent
 - 3. Project Manager
 - 4. Owner or Owner's Representative
 - 5. Major subcontractors
 - 6. Major suppliers
 - 7. Architect's Representative
 - 8. Consultants as needed
 - 9. Third-party Consultants
 - 10. Others as appropriate

- D. Meeting Agenda, may include, but is not limited to:
 - 1. Discussion on major subcontracts and suppliers and projected construction schedules.
 - 2. Critical work sequencing.
 - 3. Major equipment deliveries and priorities. Discussion of long lead time items.
 - 4. Project coordination and designation of responsible personnel.
 - 5. Procedures and processing of field decisions, proposal requests, requests for information (RFIs), submittals, minor changes, change orders and applications for payment.
 - 6. Method of distribution of contract documents.
 - 7. Procedures for maintaining record documents.
 - 8. Use of premises, office work and storage areas, on-site parking, and owner's requirements.
 - 9. Construction facilities and temporary utilities.
 - 10. Housekeeping procedures.
 - 11. Special owner requirements (specifications sections 01 35 23, 01 35 23.1 and 01 35 23.2)
 - 12. Lien release requirements

3.2 PRE-DEMOLITION CONFERENCE

- A. Owner will:
 - 1. Administer pre-demolition conference for the establishment of communication methods related to demolition procedures and Owner coordination and scheduling requirements for demolition scope.
- B. Location: At Project site or as designated by the Architect.
- C. Attendance:
 - 1. Contractor or Contractor's Representative
 - 2. Job Superintendent
 - 3. Project Manager
 - 4. Owner or Owner's Representative
 - 5. Major Subcontractors
 - 6. Demolition Subcontractors
 - 7. Architect's Representative
 - 8. Consultants as needed
 - 9. Third-Party Consultants
 - 10. Others as appropriate
- D. Meeting Agenda, may include, but is not limited to:
 - 1. Discussion on projected demolition schedules.
 - 2. Procedures for coordination of demolition sequencing and scheduling.
 - 3. Procedures for coordination associated with existing building components need to be returned to Owner.
 - 4. Project demolition coordination and designation of responsible personnel.
 - 5. Procedures for maintaining record documents.
 - 6. Special owner requirements (specifications section 01 36 13).

3.3 PROGRESS MEETINGS

- A. Architect will:
 - 1. Schedule project meetings throughout progress of the work at intervals to be determined.
 - 2. Set agenda and administer said meetings.
 - 3. Preside over meetings.
 - 4. Record meeting minutes, including all significant proceedings and decisions.
 - 5. Reproduce and distribute copies of meeting minutes within seven (7) days, excluding weekends and holidays, after each meeting to:
 - a. All participants in the meeting.
 - b. All parties affected by decisions made at the meeting.

- B. Contractor shall:
 - 1. Make physical arrangements for meetings.

- C. Attendance:
 - 1. Contractor or Contractor's Representative
 - 2. Job Superintendent
 - 3. Project Manager
 - 4. Owner or Owner's Representative
 - 5. Major subcontractors
 - 6. Architect's Representative
 - 7. Consultants as needed
 - 8. Others as appropriate

- D. Meeting Agenda, may include, but is not limited to:
 - 1. Review and approval of minutes of previous meeting.
 - 2. Review of work progress since previous meeting.
 - 3. Field observations, problems, and conflicts.
 - 4. Review of off-site fabrication and delivery schedules.
 - 5. Corrective measures and procedures to regain projected schedule.
 - 6. Review three week "look-ahead" construction schedule.
 - 7. Maintenance of quality standards.
 - 8. Response to request for information (RFIs) and status of outstanding RFIs.
 - 9. Status of submittals.
 - 10. Status of CPRs.
 - 11. Status of MCS.
 - 12. Other items and critical issues affecting work.

3.4 PRE-INSTALLATION CONFERENCES

- A. Architect will convene a pre-installation conference, when required in individual specification Section, prior to the Contractor commencing Work of the Section. The Contractor will produce agenda, Architect will distribute copies of the pre-installation conference minutes within seven (7) days, excluding weekends and holidays, after each conference to all participants in the meeting, the Owner and all parties affected by decisions made at the meeting.

- B. Attendance:
 - 1. Contractor's Superintendent(s)
 - 2. Subcontractor's Foreman
 - 3. Contractor's Project Manager(s)
 - 4. Architect's Representative
 - 5. Consultants as needed
 - 6. Owner or Owner's Representative
 - 7. Manufacturer's Representative
 - 8. Others affecting or affected by Work.
 - 9. Third party inspectors

- C. Meeting Agenda, may include, but is not limited to:
 - 1. Review of conditions of installation.
 - 2. Preparation and installation procedures.
 - 3. Coordinate with related work
 - 4. Review of the contract document requirements.
 - 5. Questions related to work required.
 - 6. Mockup samples or panels

3.5 MONTHLY PAY APPLICATION REVIEW MEETINGS

- A. The Owner, Architect, and Contractor shall schedule and conduct monthly Pay Application review meetings during the entire duration of construction prior to the submission of the notarized completed Contractor Application for payment to the Architect for certification. The Contractor shall produce a draft of the proposed Application for Payment for review by the Owner and Architect. The Contractor shall include and furnish the following documents for review:
 - a. Draft of the Contractor's Application for Payment (AIA Document G702)
 - b. Invoices for any stored materials included in the Application. Invoices shall include full descriptions and costs as required to facilitate on-site review
 - c. Release of Liens from Subcontractors and Sub-subcontractors for all work billed in previous certified Applications for Payment.
 - d. Owner reserves the right to require Release of Liens for any previously submitted notice of claim submitted by any Subcontractor, Sub-subcontractor, or suppliers.
 - e. Evidence of payment for any and all backcharges, overtime, etc. previously issued by Owner that would be past due by the time payment is made by Owner.
 - f. Pay Application review checklists fully completed.
 - g. Updated project schedule
 - h. Owner may withhold payment on line items for which a lien or claim (or similar notice of intent) has been filed, until satisfactory release has been received and accepted by Owner.
- B. Attendance:
 - a. Owner's representative
 - b. Architect
 - c. Contractor
 - d. Subcontractors as appropriate
- C. Meeting agenda may include, but is not limited to:
 - a. Review percentages of work completed and being billed to date.
 - b. Review of any stored materials being billed to date and all associated surety recommendations
 - c. Review of lien releases, notices of claims, etc.
 - d. Confirmation of approved CPRs
- D. The meeting date shall be determined by the Architect, Contractor, and Owner, and shall occur on that same date each month.

3.6 SAMPLE MEETING AGENDA

Refer to the following pages for a sample Pre-Construction Meeting agenda.

3.7 SUBMISSION OF FINALIZED APPLICATION FOR PAYMENT

Refer to AIA Document A201TM-2017, as amended, Article 9.

SAMPLE PRECONSTRUCTION MEETING AGENDA:

**PROJECT NAME
CYPRESS-FAIRBANKS INDEPENDENT SCHOOL DISTRICT**

**CYPRESS-FAIRBANKS I.S.D. BID NUMBER:
PRE-CONSTRUCTION CONFERENCE**

AGENDA

Date:
Time:
Location: Cypress-Fairbanks Independent School District
Facilities and Construction Office
11430 Perry Road
Houston, Texas 77064

I. INTRODUCTION OF PERSONNEL

| | | | |
|----|------------------------|--------------------------|----------------|
| A. | OWNER: | Cypress-Fairbanks I.S.D. | (281) 897-4108 |
| 1. | Name | Title | Phone Number |
| B. | ARCHITECT: | | |
| 1. | Name | Title | Phone Number |
| C. | CONTRACTOR: | | |
| 1. | Name | Title | Phone Number |
| D. | THIRD PARTY INSPECTORS | | |
| 1. | Name | Title | Phone Number |

II. REVIEW CONSTRUCTION GUIDELINE REQUIREMENTS

III. SUB/TRADE START-UP MEETINGS

IV. REVIEW CONSTRUCTION PROGRESS MEETING PROCEDURES

V. SPECIAL OWNER REQUIREMENTS

VI. DOCUMENTS MODIFYING AND/OR CLARIFYING THE CONTRACT

- A. Minor Change Form
- B. Change Proposal Request Form
- C. Clarification
- D. Construction Change Directive
- E. Warranty Work Request
- F. Change Order Form
- G. Claims for additional time since last meeting (weather delays, etc.)

VII. SCHEDULE, SITE OPERATIONS SET-UP AND MOBILIZATION

VIII. DISCUSSION

IX. LIEN RELEASE LOG AND BACKCHARGE LOG REVIEW

X. CLOSEOUT REQUIREMENTS

MEETING ADJOURNMENT

PROJECT:

CONSTRUCTION GUIDELINE REQUIREMENTS

The Construction Guideline Requirements supplement the project documents and procedures established for the cooperation and coordination between the Contractor, Architect, and related activities scheduled throughout the construction project.

I. RECORD DOCUMENTS AT JOB SITE

- A. The Contractor shall maintain throughout the construction of the project a record set of documents at all times secured to the document table. These plans shall be updated to reflect any changes to the original drawings. Field clarifications, minor changes, addenda, and change orders are to be posted and/or noted on these drawings to document the actual project record conditions.
- B. The Contractor, at all times, shall maintain a record set of project specifications reflecting the information noted in Item 01.

II. TESTING PROCEDURES

- A. The Testing Laboratory shall be scheduled through the General Contractor to monitor the soils, concrete, rebar, structural steel, and other testing services required throughout the project. The General Contractor will be required to provide a 48-hour advanced notice to the testing laboratory for scheduled inspections.
- B. Concrete pours shall be scheduled by the General Contractor 48 hours in advance of the scheduled pour. The General Contractor will be responsible for scheduling both Architect's representative and the testing laboratory for observation and testing of the scheduled concrete pour. Unless prior approval has been arranged, all concrete pours are to be made in the presence of the testing laboratory and/or Architect's representative, following their review of all reinforcing steel and miscellaneous items.

III. FIELD INSPECTIONS

- A. Mechanical, Electrical, and Plumbing inspections shall be in compliance with the contract documents. Excavation, materials, installation, backfill, and cover-up shall be reviewed by a representative from Architect, the Owner, and/or an outside consultant in the required sequences for each scheduled activity. The General Contractor will be required to provide a 24-hour advance notice for each scheduled activity to be reviewed.

IV. SUBMITTALS

- A. Shop Drawings and/or submittals shall be submitted to the Architect in the required quantities (re: specs), with the Contractor's stamp affixed to all items and signed by the Contractor signifying he has reviewed each submittal and it meets exceeds all Contract requirements. Shop drawings or submittals not containing this information will be returned not approved. Commencement of work without reviewed and approved shop drawings will not be permitted. The Contractor will provide a list of shop drawings and/or submittals within 1 month of contract award noting the critical and/or priority items requiring immediate review and approval. Dates for submission of all items will also be provided. A complete set of shop drawings shall be maintained at the field office and their status reviewed at each construction progress meeting.

V. CHANGES IN THE WORK

- A. Change Requests involving additions, deletions, and/or revisions to the contract documents must be submitted by the Contractor to Architect's office in writing accompanied by an itemized material, labor, and equipment breakdown for review and approval prior to any changes occurring. Response to all minor changes and proposal requests must be submitted to Architect within 20 days for review and response.

VI. LIST OF SUBCONTRACTORS

- A. A list of each Subcontractor scheduled to perform work on the project should be submitted to Architect at the start of the project with Schedule of Values and before review of the first Application for Payment. (Use AIA Document G805)
- B. Prior to the commencement of work by each Subcontractor, a meeting will be scheduled to review the requirements, materials, and/or equipment specified in the contract documents.

VII. SCHEDULE OF VALUES

- A. The Schedule of Values shall be approved by Owner and Architect prior to submitting the first pay application. This Schedule shall include the monetary values for each item of construction, breaking out the labor and material for each activity. (Use AIA Documents G702 and G703)

VIII. PROGRESS SCHEDULE

- A. Progress Schedules shall be approved by Owner and Architect prior to submitting the first pay application. This schedule shall be a graphical projection of construction activities subdivided into various components and outlining the anticipated starting and completion dates. Indicate the "critical path" items and update the schedule monthly and recovery if required.

IX. CONTRACTOR'S APPLICATION FOR PAYMENT

- A. Pay applications will be reviewed monthly at the project site. The pay application will be in a preliminary draft for the review by Architect's and the Owner's representative. The reviewed, accepted, and/or modified pay application will be submitted to Architect's office for processing. Affected subcontractors and/or material suppliers are requested to be present at each pay application review. Progress schedules are to be revised and updated monthly and submitted with each preceding application for payment.
- B. Stored materials are required to be in accordance with Section 9.3.2.

X. PROGRESS MEETINGS

- A. Progress meetings will be held to discuss job progress, coordination, schedule, and anticipated conflicts. Those in attendance will be the Owner, Architect, General Contractor, affected subcontractors, and/or particular consultants. Frequency of the progress meetings will be determined by job conditions. The Architect will keep accurate minutes of the meetings and distribute copies to all in attendance.

XI. LINES OF COMMUNICATION

- A. The Architect is the Owner's representative and all communications between the Owner and General Contractor shall be channeled through the Architect. Subcontractors shall correspond with the Owner and/or the Architect through, or in the presence of, the General Contractor.
- B. The Superintendent shall be fully knowledgeable of the contract documents. Review and approval by the Superintendent of all items prior to observations by the Architect and/or Owner's representative is essential in avoiding project delays and re-inspection of nonconforming work.

XII. ADDITIONAL SERVICES

- A. Additional architectural or engineering services and testing or retesting to analyze and inspect nonconforming work shall be at the Contractor's expense.

XIII. APPROPRIATE CONDUCT

- A. Appropriate conduct and language must be exercised by all construction workers. Appropriate clothing must be worn at the job sites by all workers. Misconduct involving a worker will constitute immediate dismissal and removal of said worker from the project site.
- B. The Contractor shall comply with all Special Owner Requirements per Specification Section 01 35 23 herewithin.

XIV. SUBSTITUTIONS

- A. Substitutions not approved prior to proposal will not be considered.

XV. SUBSTANTIAL COMPLETION AND CLOSE OUT

- A. The General Contractor shall submit in written form a list of items requiring completion (per contract requirement) and/or correction along with a written request for substantial completion.
- B. The General Contractor shall submit all of the required documents, information, and materials to the Architect to expedite project close-out as outlined in the Project Close-Out Specifications.

PROJECT:

CONSTRUCTION TRADE START-UP MEETING GUIDELINES

The Architect shall direct the General Contractor to arrange a time and location 48 hours prior to a new trade commencing work for the purpose of reviewing and discussing the project documents and specifications governing the particular Subcontractor's work.

The reviews should include, but not be limited to, the following:

1. Determine if all appropriate shop drawings, samples, and/or literature has been submitted, reviewed, and approved.
2. Determine if the Subcontractor has all the current documents to begin and complete his work in compliance with the contract.
3. Inform the Subcontractor/Foreman that if inspections will be needed, the Contractor must provide the Architect with a 48-hour advance notice.
4. Review with the Contractor and Subcontractor any storage or temporary staging areas required and whether there will be conflicts with other trades.
5. Determine if Subcontractor/Foreman has knowledge of what area his work will commence and the sequence to be followed.
6. Examine thoroughly each part and section of the specifications, noting materials, workmanship, manufacturer's recommendations, installation, etc.
7. Alert the Contractor and Subcontractor to special conditions outlined in the project documents and/or project specifications required by the Architect, Owner, or related Consultants.
8. Emphasize that clean-up is a very important item in the overall construction of the project and that an unsightly project will not be tolerated.
9. Inquire if there are any questions relating to the specific areas covered or questions about areas not specifically covered.
10. Review coordination drawings required by Contract.

PROJECT:

JOB PROGRESS MEETING GUIDELINES

The Architect shall consult with the Owner's representative to determine at what intervals progress meetings will occur. The Architect shall inform the General Contractor of the time, date, and locations of the Construction Progress Meetings and the regularity of the proposed scheduled meetings.

ARCHITECT

1. The Architect shall prepare a Record of Attendance sign-in sheet for those attending the progress meeting.
2. The Architect shall preside over the order of the meeting. The Architect shall then recognize the General Contractor's representative, who will address the items outlined under the Contractor.
3. Following the completion of the Contractor's agenda, comments will be received and/or offered by the Owner, Architect, Contractor, and any member in attendance at the progress meetings.
4. The Architect shall submit to the Owner and Contractor notes describing the accounts of the progress meeting, including the time, date, and location of the next scheduled meeting.
5. The Architect, upon reviewing the previous meeting minutes with the Owner and General Contractor, shall amend, add to, or accept as submitted. The meeting notes will then be mailed to the Owner and Contractor for their record copy of the accepted meeting notes.

CONTRACTOR

1. The Contractor, at the beginning of each progress meeting, shall submit an agenda outlining those scheduled to attend, an updated progress schedule, and any other matters of interest requiring discussions and/or immediate response affecting the overall construction progress.
2. The progress meetings shall be attended by the Project Manager, Field Superintendent, representatives from trades in progress or trades to begin work prior to the next scheduled meeting. Materials suppliers and/or other representatives impacting the current or near-current construction schedule shall also be in attendance.
3. The Contractor shall review and update the construction schedule by noting progress, work in progress, and anticipated work to begin. Areas of delays in deliveries, materials, equipment, manpower, utilities, pending architectural responses, and/or pending Owner responses that may affect the construction progress shall be addressed in conjunction with the construction progress schedule.

END OF SECTION

SECTION 01 31 29

NOTIFICATION OF ARCHITECT REQUIREMENTS

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 REQUIREMENTS

- A. In general, the Contractor shall notify the Architect whenever there is need of clarification of interpretation of the Contract Documents.
- B. The Contractor shall notify the Architect 48 hours in advance of certain stages of construction. The project superintendent shall notify the Owner's Representative on an ongoing basis of ongoing work. These stages shall include, but are not necessarily be limited to the following:
1. Division 2, Division 31 - Clearing of site.
 2. Div 31-33 - Stripping of top soil within limits of grading.
 3. Div 31-33 - (Excavation and) Placing (of each lift of) select fill material.
 4. Div 31-33 - Compaction, inspection, testing, and covering of underground utilities.
 5. 31 63 29 - Drilled and reamed foundation piers.
 6. 31 23 00 - Excavation of grade beams.
 7. 03 30 00, 04 22 13 - Placing of concrete.
 8. 07 81 00 - Concealment of insulation.
 9. 07 84 00 - Installation of firestopping and firesafing.
 10. 07 52 19 - Modified Bitumen Membrane Roofing System
 11. 07 92 00 - Installation of building and glazing sealants.
 12. 08 80 00 - Installation of glazing and glazed systems.
 13. 09 21 16 - Installation of gypsum wallboard.
 14. 09 30 13 - Installation of ceramic tile.
 15. 09 51 00 - Installation of acoustical ceiling (grid and panels).
 16. 09 65 19 - Installation of resilient flooring and base.
 17. 09 68 00 - Installation of carpeting.
 18. Division 09 - Painting and staining (each coat), Elastomeric coatings, etc.
 19. Division 02 - Abatement work
 20. Division 23 - Installation of heating, ventilating and air conditioning system.
 21. Division 23 - HVAC system startup
 22. Division 22 - Installation of plumbing fixtures.
 23. Divisions 21-26 - Any and all testing and training specified for equipment, mechanical, electrical and plumbing systems.
 24. Divisions 21-26 - Completion of roughing-in of plumbing, heating, air conditioning and electrical work (prior to concealment).
 25. Division 26 - Initiation of permanent power
 26. Division 26 - Installation of all electrical fixtures.
 27. Division 27-28 - Installation of all data, low voltage, security, special systems, fire alarm, and misc. technology systems.
 28. Notify the Architect and the Owner: All pre-construction or trade startup meetings.
 29. Owner shall be given notification/opportunity to conduct inspections prior to wall or ceiling cover up.
- C. In addition to notifying the Architect, the Contractor shall also notify the Structural Engineer (48 hours) prior to the following stages:
1. Drilling, reinforcing, and placing of first piers and footings.
 2. Placing first reinforcing and grade beams.
 3. Erecting structural steel elements.

- D. Above ceiling inspections shall be completed prior to cover up. All systems are to be reviewed at the same inspection. All systems shall be 100 percent complete prior to inspection.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

3.1 PRE-CONSTRUCTION CONFERENCE

- A. The Contractor shall contact Architect at least ten (10) days prior to commencing construction in order for Architect to schedule a pre-construction and/or trade startups meeting with Contractor, Architect, Owner, and third-party firms. This meeting must occur prior to commencement of any construction.

3.2 CONFERENCES AND MEETINGS

- A. Refer to Section 01 31 19, Project Meetings for requirements pertaining to Pre-construction Conference, Progress Meetings, and Pre-installation Conferences.

END OF SECTION

SECTION 01 32 16

CONSTRUCTION PROGRESS SCHEDULE

CONDITIONS OF THE CONTRACT and DIVISION 1, as indexed, apply to this Section.

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Refer to Instructions to Proposers for substitutions.

1.2 SUBMITTALS

- A. Schedules:
 - 1. Preliminary Analysis: Within fourteen days after receipt of Notice to Proceed, submit a preliminary construction schedule for review.
 - 2. Construction Schedule: Within four weeks after receipt of Notice to Proceed, submit one reproducible and four prints of the construction schedule.

1.3 RELIANCE UPON SCHEDULE

- A. The construction schedule as approved by the Architect will be an integral part of the Contract, and will establish conditions for various activities and phases of construction.

PART 2 - PRODUCTS

2.1 CONSTRUCTION SCHEDULE

- A. Diagram: Graphically show the order of all activities necessary to complete the work and the sequence in which each activity is to be accomplished.
- B. General Requirement:
 - 1. Contractor shall provide a completed Project Schedule as outlined below 14 days after Contract Award for review and comment by Owner and Architect
 - 2. Activities shown on the schedule shall include, but not necessarily be limited to:
 - a. Project mobilization.
 - b. Submittals and approvals of shop drawings and samples.
 - c. Phasing of construction.
 - d. Procurement of equipment and critical materials.
 - e. Fabrication and installation of special material and equipment.
 - f. Final clean-up.
 - g. Final inspection and testing.
 - h. Air and water balancing.
 - i. Demonstrations for Owner and Owner's staff.
 - j. Punch lists.
 - k. Project closeout.
 - l. Commissioning Schedule
 - 3. The project Schedule shall be divided by trade/spec section and by area of the building with each section to include such items as material delivery dates, below-grade finish/install, above-grade finish/install, trimout, etc. Detail to include specific components of the trade being scheduled (for example: painting would show clean/prep. Block fill, first coat, finish coat, etc.).
 - 4. Project Schedule shall include the amount of anticipated weather days allocated for the Project at the appropriate months, and should also include such milestones as permanent power, chiller startup, etc. where applicable.

5. Contractor shall complete the subcontract trades buyout process 30 days after the Contract award.
6. Contractor shall ensure that all required submittals are submitted for review no later than 60 days after Contract award.
7. Project schedule shall be initially scheduled to allow Initial Completion 60 days prior to Substantial Completion. The 60-day period between Initial Completion and Substantial Completion shall be allocated for such items as the following:
 - a) *Initial Final Clean*
 - b) *Trial owner's systems testing*
 - c) *Owner's tests and inspections*
 - d) *Owner's systems demonstrations*
 - e) *Establishment of required stand of grass*
 - f) *Correction of Contractor's punch list*
 - g) *Owner/Architect punch list*
 - h) *Correction of Owner/Architect punch list*
 - i) *Final clean to deliver building after all tests and inspections*
 - j) *Substantial Completion*
 - k) *Test and Balancing*
 - l) *Commissioning*
8. Schedule shall also include a review of O&M manuals 30 days prior to Substantial Completion and shall include submission of a closeout document binder mock-up.

2.2 CONSTRUCTION SCHEDULE LIMITATIONS

- A. Work performed under this Contract shall be performed in accordance with the following paragraphs so that the Owner can accept the project as substantially complete as noted below.
- B. The project schedule begins upon Notice to Proceed and continue uninterrupted with the following requirements:
 1. The entire project shall be substantially complete by dates noted in the Standard Form of Agreement between Owner and Contractor (AIA Document A101™-2017, as amended) subject to Liquidated Damages as listed in General Conditions of the Contract for Construction as amended (AIA Document A201™-2017, as amended) and Supplemental Conditions (Section CB).
- C. Certificates of Substantial Completion may be issued for any of the above-mentioned areas of work which are complete prior to the completion of the entire project, provided that all contract requirements for Substantial Completion are met for that portion of the Work. However, warranties shall commence on date of Substantial Completion of entire project. Maintenance required by equipment manufacturers shall be performed by Contractor through the agreed-upon Substantial Completion date, unless specified otherwise in the Contract Documents.
- D. For work during Summer: Any construction related activities after (Last Day of School) and before the start of the next school year, must occur during CFISD normal working hours of Monday through Thursday (10-hour days) or the contractor must request and pay for overtime request to have the building open per Special Owner Requirements Section 01 35 21.1. This requirement will also apply to any work during the school year outside the normal CFISD working hours. The 4-day/10-hour day schedule will only be applicable during scheduled summer break.

END OF SECTION

SECTION 01 32 23 - SURVEY AND LAYOUT DATA

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 QUALITY CONTROL

- A. Conform to State of Texas laws for surveys requiring licensed surveyors. Employ a surveyor acceptable to Owner's Representative if required by the Contract.

1.2 SUBMITTALS

- A. Conform to requirements of Division 1.
- B. Submit name, address, and telephone number of Surveyor to Owner's Representative before starting survey work.
- C. Submit documentation verifying accuracy of survey work on request.
- D. Submit certificate signed by Surveyor, that elevations and locations of the Work are in conformance with the Contract.

1.3 PROJECT RECORD DOCUMENTS

- A. Maintain a complete and accurate log of control and survey work as it progresses.
- B. Prepare a certified survey setting forth dimensions, locations, angles, and elevations of construction and site work upon completion of foundation walls and major site improvements.
- C. Submit record documents under provisions of Division 1.

1.4 EXAMINATION

- A. Verify locations of survey control points prior to starting the Work.
- B. Notify Owner's Representative immediately if any discrepancies are discovered.

1.5 SURVEY REFERENCE POINTS

- A. The Owner will establish survey control datum as indicated on Drawings. Inform Owner's Representative in advance of time additional horizontal and vertical control points will be established so verification deemed necessary by Owner's Representative may be done with minimum inconvenience to the Owner or Contractor.
- B. Locate and protect survey control points prior to starting site work; preserve permanent reference points during construction.
- C. Notify Owner's Representative a minimum of 48 hours before relocation of reference points is needed due to changes in grades or other reasons.
- D. Promptly report loss or destruction of reference points to Owner's Representative.
- E. Reimburse the Owner for cost of reestablishment of permanent reference points disturbed by construction operations.

1.6 SURVEY REQUIREMENTS.

- A. Utilize recognized engineering survey practices.
- B. Establish a minimum of two permanent benchmarks on site, referenced to established control points. Record horizontal and vertical location data on Project record documents.
- C. Establish elevations, lines, and levels to provide quantities required for measurement and payment and for appropriate controls for the Work. Locate and lay out the following with appropriate instruments:
 - 1. Site improvements including grading, fill and topsoil placement, utilities, and footings and slabs.
 - 2. Grid or axis for structures.
 - 3. Building foundation, column locations, and ground floor elevations.
- D. Periodically verify layouts.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

SECTION 01 33 00

SUBMITTALS

CONDITIONS OF THE CONTRACT and DIVISION 1, as indexed, apply to this Section.

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Refer to Section AB for substitutions.

1.2 PROCEDURES

- A. Transmit each item with approved form identifying project, contractor, subcontractor, major supplier; identify pertinent drawing sheet and detail number and specification section number, as appropriate. Identify deviations from Contract Documents.
- B. Apply Contractor's stamp, signed, to each item submitted, certifying that review and verification of products, field dimensions, adjacent construction work and coordination of information is in accordance with the requirements of the work and Contract Documents.
- C. Revise and resubmit submittal as required; identify all changes made since previous submittal.
- D. After review, distribute copies to all concerned parties.

1.3 SHOP DRAWINGS AND PRODUCT DATA

- A. Refer to AIA Document A201™-2017, General Conditions of the Contract for Construction; as amended, 3.12.13 for the number of copies required. Transmit Consultant and Engineering submittals directly to respective consultants with a transmittal to the Architect.
- B. The Contractor shall provide composite drawings within 4 weeks of Notice To Proceed, showing how all piping, ductwork, lights, conduit, and equipment, etc. will fit into the ceiling space allotted, including clearances required by the manufacturer, by Code, or in keeping with good construction practice. Space for all trade elements must be considered on the same drawing. Drawings shall be 1/4 inch per foot minimum scale and shall include invert elevations and sections required to meet the intended purpose.
- C. Manufacturer's Instructions: When work is specified to comply with manufacturer's printed instructions, obtain and distribute copies of such instructions to parties involved in the installation, including two copies to Architect at least two weeks prior to start of such work.
- D. All dimensions indicated on the drawings are based on the specific models and manufacturers of products, equipment, fixtures, and miscellaneous items specified. If the Contractor uses an approved product by another listed manufacturer which is different than the specific model and manufacturer listed in these specifications, then the Contractor shall be solely responsible for the coordination of any dimensional changes required, including structural, relocation of walls, equipment, fixtures, ceilings, and miscellaneous items. When dimensional changes are required in these situations, the Contractor shall submit a proposed modification drawing to the Architect for approval prior to proceeding with the work. All causes and effects of the dimensional change shall be indicated on the Contractor's drawing submittal.

1.4 SAMPLES

- A. Submit full range of manufacturer's standard colors, textures, and patterns for Architect's selection. Submit samples for selection of finishes in accordance with approved schedule, and in such sequence as to cause no delay in the work or in the work of any other Contractor. All color samples to be physical samples, not digital unless requested by Architect.

- B. Submit samples to illustrate functional characteristics of the product, with integral parts and attachment devices. Coordinate submittal of different categories for interfacing work.
- C. Submittals shall contain:
 - 1. Date of submission and dates of any previous submissions
 - 2. Project title and number
 - 3. Contract identification
 - 4. Names of Contractor, Supplier, Manufacturer
 - 5. Identification of sample, with specification section number
 - 6. Note any deviation from contract documents
- D. Resubmission Requirements for Samples:
 - 1. Make any corrections or changes in the submittals required by the Architect and resubmit until approved.
 - 2. Submit new samples as required for initial submittal.
- E. Submit the number specified in the respective Specification section; minimum of two, one will be retained by Architect. Reviewed samples may be used in the work if so indicated in the specification section.

2. MANUFACTURER'S CERTIFICATES AND WARRANTIES

- A. Submit required certificates and warranties in duplicate.

END OF SECTION

SECTION 01 35 23

SPECIAL OWNER REQUIREMENTS

This Section has been added to identify and reinforce specific items that are currently defined in depth in the specifications, and that are of great importance to Cypress-Fairbanks Independent School District. The Owner of the Construction Company making an offer on the project must sign this document and an original, notarized copy will be attached to the Construction Contract.

1. **Substantial Completion: Refer to the General Conditions of the Contract for Construction as amended, Paragraph 9.8.**
2. **Documentation of Existing Conditions**
 - a. Conditions of improvements (roads, landscape areas, signage, building exterior and interior, etc.) at the building site where work is scheduled to occur are considered to be in good condition. The Contractor shall document through the use of digital video, any existing defects in areas where work will actually be performed, including but not limited to, staging areas and areas of circulation around the site, prior to the start of any construction. Contractor shall also test and document building and site systems (fire alarm, sound, irrigation, etc.) These systems are considered to be in good operating condition unless documented otherwise. A copy of all digital video (flash drive) must be filed with the Owner prior to the start of any construction. Any and all defects not specifically identified prior to construction shall be repaired/replaced by the contractor to the satisfaction of the Owner, at no additional cost.
3. **Application for Payment:**
 - a. Pay application(s) must be correctly completed and executed by the Contractor. All numerical columns and tabulations should be correctly totaled to the nearest cent. With each pay application, Contractor shall also submit partial lien releases from all sub-contractors and major suppliers on the form included in this Project Manual, for work performed through the previous accounting period, an updated construction schedule and construction progress photographs. All lien notices received by the Owner from the previous pay period must be cleared by submission of an unconditional release of lien prior to submission and approval of current applications for payment. Noncompliance with these requirements will result in the return of the Application for Payment(s) to the Contractor for correction and resubmittal. Final application for payment shall only be submitted to the Owner upon completion of all close out requirements including but not limited to receipt of Record Documents, Operation and Maintenance Manuals, Owner Orientation and Training Meetings, Consent of Surety, Contractor Final Release of Lien, Contractor's Affidavit of Payment of Debts and Claims, and unconditional final lien releases from all subcontractors, sub-subcontractors and major suppliers and any other closeout requirements per the contract documents.
 - b. **If errors are discovered by the Owner in certified applications for payment, the Owner shall reject the application and return it to the contractor for correction. The specified time period for payment of such applications will start over on the date the Owner receives the corrected certified application for payment from the Architect.**
4. **Construction Schedule:**
 - a. Refer to Section 01 32 16. The Contractor shall provide a detailed construction schedule at the start of the project and shall submit an updated schedule at the weekly construction meetings. This schedule will also identify the estimated percentage of work completed to date for each item of work along with percentage of work remaining to be completed. This information will be used in the verification of the Contractor's Application for Payment. Application for Payment will not be reviewed, approved, and processed without submittal of the initial schedule and subsequent updated schedules throughout the duration of the project.

5. Use of Alcohol and Tobacco Products:

- a. Smoking and the use of all tobacco and alcohol products are prohibited at all times on Cypress-Fairbanks ISD property, including the field office. The Contractor will be fined \$250.00 for each infraction of this policy. In addition, the Owner reserves the right to have the Contractor's personnel dismissed from the District property. This policy is strictly enforced by all employees of Cypress-Fairbanks ISD.

6. Reinspection Fees:

- a. During the course of the project, should additional inspections be required by the Owner or Consultants to review problems directly created by and attributable to the Contractor, then all associated expenses including mileage shall be deducted from funds remaining to be paid to the Contractor. The Owner or Architect will verbally inform the General Contractor of the intent to request additional reinspection fees at the time of the occurrence and will provide written invoicing within thirty (30) working days after the date of the occurrence.

7. Job Superintendent:

- a. The Contractor will be required to keep the job superintendent on the job site full-time during the course of the job until completion of all punch list items. In the event the job superintendent is absent from the job site at any time during the project contract time or during punch list completion and a previously agreed upon substitute is not provided, the Owner may fine the Contractor \$250.00 per occurrence.
- b. The Owner is to be notified at the beginning of the workday if the job superintendent is out sick. If the superintendent is out for any other reason, the Owner is to be notified at least twenty-four (24) hours in advance. In both cases, the Owner is to be informed of the name of the acting job superintendent.
- c. Subcontractors, Sub-subcontractors are not allowed to work unsupervised on the jobsite at any time during the performance of the work including overtime and weekends.
- d. Where multiple sites are part of the construction contract, the Contractor shall furnish a full-time superintendent for each project campus work is to be performed unless otherwise specified or agreed to by the Owner.

8. Site/Building Rules and Regulations

- a. The Contractor shall adhere to the following building rules and regulations during the performance of the work within this contract. The Owner will back charge the Contractor in the amount of \$250.00 per occurrence for any violations of any of these rules and regulations. In addition, the Owner reserves the right to remove the person committing the violation permanently from the project site.
 1. No foul language or spitting will be allowed on district property and within the interior of the buildings.
 2. The possession of tobacco products, firearms, alcohol, or illegal drugs is strictly prohibited on school property and is a state and federal law and subject to criminal charges for any such violation.
 3. Workers must be fully clothed. Shorts and tank tops are not allowed on school property.
 4. The Contractor's personnel shall demonstrate professional behavior and respect toward all school district personnel and property. Physical, verbal, or visual contact with students is strictly prohibited.
 5. Any worker with a history of felony convictions or warrants is strictly prohibited from working on district property. The District has the right to perform criminal checks on any worker the Contractor and/or its subcontractors proposes to use on the project prior to

- issuance of security identification badges. The Owner reserves the right to check such records anytime during construction if the Owner deems it necessary for the safety and protection of the students and staff.
6. The Contractor's personnel are not allowed to park on any grass area, under shade trees, sidewalks, or non-vehicular paved areas. The Contractor will be held liable for any resultant damages resulting from the violation of this requirement.
 7. Authorization must be obtained in advance with the campus administrator or the Facilities Planning and Construction Department to enter or access any existing facility campus.
 8. The Contractor, subcontractors or sub-subcontractors shall keep the premises and site free from accumulation of waste, materials or rubbish caused by the work under this contract at each site. Boxes must be broken down prior to removal from the building. Upon completion of the contract work, and prior to the final inspection, have the premises in a neat and clean condition.
 9. The Contractor shall take all precautions necessary for the safety of, and provide protection to prevent damage, injury or loss to:
 - a. All employees on the project and all other persons who may be affected thereby.
 - b. All the work with all the materials to be incorporated therein, whether in storage on or off the site.
 - c. All property at the site and adjacent thereto including trees, shrubs, lawns, walks, pavements, roadways, structures, utilities, and any other school property.
 10. A competent supervisor who understands the full scope of the work shall be on-site at all times while work is being performed and remain on-site until all punch list items have been completed as specified here within this specification section.
 11. The Contractor shall be responsible to Cypress-Fairbanks I.S.D. for acts and omissions of the Contractor's employees, subcontractors and their agents and employees, and other persons performing portions of the work under the contract.
 12. The Contractor shall not perform any work within the confines of a secured building on a renovation/addition project or after Substantial Completion on a new Project without the District having one District custodian present during performance of the work. The contractor must reimburse Cypress-Fairbanks I.S.D. Operations Department for the overtime costs associated with the after-hours work as specified within this specification section. Refer to Special Owner Requirements Overtime Section 01 35 23.1.
 13. All exterior doors must be kept closed at all times.
 14. All workers must wear badges at all times when on CFISD property. Refer to Special Owner Requirements Badging Section 01 35 23.2
 15. All deliveries shall be received and signed for by the Contractor and not by Cypress-Fairbanks ISD personnel. The Contractor shall post signs, in a location agreed upon by the Owner's Representative, stating where deliveries are to be received and who is to sign for them.

Signature form follows on next page.

By signature of this document, I hereby state that I (or designated representative of this Company as indicated below) have reviewed the project sites, reviewed the Contract Documents, and read the Specifications including the General Conditions as Amended, Supplementary Conditions and Special Owner Requirements in their entirety and do fully understand and agree to fully abide by all requirements established herein.

Respectively Submitted,

By: _____
Signature

Printed Name

Title

Company Name

Street Address

City, State, Zip Code

(Seal - if Proposer is a Corporation)

Date _____ State of _____ County of _____

Subscribed and sworn to before me this _____ day of _____

Notary Public:

My Commission expires:

NOTE: Form must be notarized and attached to the Construction Contract.

END OF SECTION

SECTION 01 35 23.1

**BUILDING OVERTIME REQUESTS
SPECIAL OWNER REQUIREMENTS**

This Section has been added to identify and reinforce specific items that are currently defined in depth in the specifications, and that are of great importance to Cypress-Fairbanks Independent School District. The Owner of the Construction Company making an offer on the project must sign this document and an original, notarized copy will be attached to the Construction Contract.

Contractor Overtime and Building Access

- A. Owner’s building personnel will be present at all times during the performance of the Work by the Contractor should Work be necessary during non-normal hours, weekend, School District employee Holidays and after the date of substantial completion. If the Contractor needs access to the sites other than normal campus working hours, notification shall be provided to the Owner’s Representative through the Facilities Planning and Construction Office Project Manager. The attached “Contractor Overtime Building Access Request Form” within this section shall be submitted for all overtime requests to obtain Owner approval.
- B. Overtime requests/scheduling: Contractor shall request with the attached form and submit by noon, a minimum of three (3) days in advance of the anticipated Work an overtime request. These requests shall be a minimum of four (4) hour charge. If Contractor does not work the entire time of requested overtime hours, the Contractor will still be responsible for paying the total requested overtime hours billing. With each request, Contractor will be billed 30 minutes to allow Operations to open and secure the building as well as 30 minutes for lunch.
- C. The Contractor shall compensate the Owner at the rate of twenty-two (\$22.00) dollars per hour for non-normal and weekend hours, and thirty-three (\$33.00) dollars per hour for School District employee Holidays.
- D. Overtime cancellations: Contractor shall request and submit by noon, a minimum of two (2) days in advance of the anticipated Work an overtime cancellation request should scheduled work and overtime not occur. If Contractor fails to cancel, they will be charged the four (4) hour minimum charge.
- E. Invoices will be submitted by the Owner to the Contractor on a monthly basis and are payable upon receipt to Cypress-Fairbanks I.S.D. Operations Department. Payment must be received within thirty (30) days of the invoice date. Owner reserves the right to refuse future overtime requests as well as the rejection of any current application for payment until such time outstanding payments are received.
- F. Hours:
 - 1. Normal School hours: 6:30 AM – 11:30 PM Monday – Friday
 - 2. Summer hours: 6:00 AM – 4:30 PM Monday - Thursday
 - 3. Not including District recognized employee Holidays per academic year calendars on District’s website: Spring Break Week, Thanksgiving Week and Winter Break
6:00 AM – 2:30 PM
 - 4. Food Production, school kitchens:

| | |
|------------|---|
| Elementary | 7:00 AM – 3:30 PM for most, verify with Owner |
| Middle | 6:30 AM – 3:00 PM for most, verify with Owner |
| High | 6:00 AM – 2:30 PM for most, verify with Owner |
- G. Package renovation and construction projects containing multiple district campuses will require overtime requests/cancellations be submitted for each building as needed.
- H. Overtime agreements made that differ from the above noted guidelines will not be accepted or honored.
- I. For site work only, the Contractor is required to complete the overtime form and submit it to the District. There will be no charge for site work only to the Contractor. The District will notify all parties to inform them work is being scheduled to be performed on our site.

Signature page continued below.

By signature of this document, I hereby state that I (or designated representative of this Company as indicated below) have reviewed the project sites, reviewed the Contract Documents and read the Specifications including the General Conditions as Amended, Supplementary Conditions and Special Owner Requirements in their entirety and do fully understand and agree to fully abide by all requirements established herein.

Respectively Submitted,

By: _____
Signature

Printed Name

Title

Company Name

Street Address

City, State, Zip Code

(Seal - if Proposer is a Corporation)

Date _____ State of _____ County of _____

Subscribed and sworn to before me this _____ day of _____

Notary Public:

My Commission expires:

NOTE: Form must be notarized and attached to the Construction Contract.

**CONTRACTOR
 OVERTIME / BUILDING ACCESS REQUEST FORM
 CYPRESS-FAIRBANKS INDEPENDENT SCHOOL DISTRICT**

| <u>CONTRACTOR:</u> | <u>CYPRESS-FAIRBANKS ISD USE ONLY:</u> |
|---|--|
| 1. Date of Request: _____ | 1. Total Overtime Hours Requested: _____ |
| 2. Project: _____ | 2. Total Overtime Amount Due Cy-Fair ISD: _____ |
| 3. CFISD Project Number: _____ | 3. Date Submitted to Operations: _____ |
| 4. Campus: _____ | 4. Date Submitted to Security: _____ |
| 5. Requested Date: _____ | 5. Date Submitted to Facilities Use: _____ |
| 6. Requested Hours: _____ (Minimum 4 hours must be requested) | 6. Comments: |
| 7. General Contractor/Subcontractors Working and contact mobile phone numbers: _____ _____ | |
| 8. Project Manager and Superintendent's Name and contact mobile phone numbers: _____ _____ | |
| 9. Requested By: _____ | |

On a monthly basis and prior to contract closeout and final payment by the Owner, the Contractor hereby agrees to reimburse Cypress-Fairbanks ISD the amount of twenty two (\$22.00) dollars per hour for non-normal days & weekend hours and thirty three (\$33.00) dollars per hour for School District employee Holidays for the above requested overtime hours. Reimbursement will be made by separate check made payable to the Cypress-Fairbanks ISD Operations Department within thirty (30) days of invoice date. If Contractor does not work the entire time of requested overtime hours, the Contractor will still be responsible for the total requested overtime hours. With each request, Contractor will be billed 30 minutes to allow Operations to open and secure the building and also includes 30 minutes for lunch.

Acknowledged and Agreed to by: _____
 Contractor's Signature Date

 Printed Name

Approved by: _____
 CFISD Project Manager's Signature Date

 Printed Name

END OF SECTION

Section 01 35 23.2

Special Owner Requirements - Badging Process

For Contractors, Sub-Contractors, Service Providers, & Vendors

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

Refer to enclosed instructions and Form AP packet for necessary submission information and procedures.

1.1 SECTION INCLUDES

- A. This Section has been added to identify and reinforce specific items that are currently defined in depth in the specifications, and that are of great importance to Cypress-Fairbanks Independent School District. The Owner of the Construction Company making an offer on the project must sign these documents and an original, notarized copy will be attached to the Construction Contract.
- B. Mandatory photo identification badge with the workers name and name of the Construction Company, which shall be worn at all times *[required after Substantial Completion for new buildings; required at all times for renovations]* shall be provided by the Owner and payable by the General Contractor. The General Contractor shall provide a list of all employees, suppliers, etc., that will be on the job site for more than 1 hour per day. The Owner reserves the right to reject issuing a security badge to any contractor employee as deemed appropriate to protect the Owner's interest. The Owner reserves the right to dismiss any worker not wearing proper identification, from the project site. Back charges are applicable for any infraction of this requirement.
- C. Lists must be forwarded to the Facilities Planning & Construction Department 72 hours or earlier in advance of going to the site.
- D. List shall be submitted on forms contained in Form AP packet.
- E. Should a Contractor want to add names to their original list, they must be added on a separate list.
- F. A maximum of 5 groups of **3-4 workers** may report to the Facilities Planning and Construction Department to have photos taken and pick-up the identification badges, based upon the agreed upon schedule. If more than the maximum number of workers show up, they will be asked to wait, or to return at a later time.
- G. Badges will include the General Contractor, Subcontractor or Sub-subcontractor name, expiration date of the project, and photo identification of the authorized person. The expiration date will typically be 6 months after the scheduled contract substantial completion date, but not longer than one year from date of issuance. Upon expiration, the contractor shall repeat the application process. There is no charge for renewal badges provided that the worker returns his previous badge. Otherwise, the \$10.00 charge applies.
- H. Badges must be worn at all times by all General Contractor, Subcontractor or Sub-subcontractor personnel on school district property during the construction of the project.
- I. The Contractor will be invoiced by Facilities Planning, & Construction and will be responsible for payment within 30 days of the invoice date.
- J. Should a person lose a badge and need a replacement, this procedure will be used to obtain the replacement badge. A \$10.00 charge for the replacement badge will be applicable for all lost badges.
- K. The Contractor shall contact Facilities Planning, & Construction with any questions during the process. The Contractor shall not contact Cypress-Fairbanks Police Department directly.

- L. Contractor shall return all project badges to CFISD. This included but is not limited to the Contractor, Sub-contractor, sub-sub-contractor, etc. Should badges not be returnable, Contractor shall submit letter in writing noting badges are lost for CFISD records as well as be assessed a fee of \$10.00 for each badge not returned to CFISD. If Contractor fails to pay such fees, the Owner will deduct such charges from the final payment.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

- 3.1 Refer to and follow the attached instructions.

END OF SECTION

SECTION 01 36 13

RENOVATION PROJECT PROCEDURES

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 REQUIREMENTS INCLUDED

- A. This Section contains general provisions and requirements pertaining to all remodeling, removal, and relocation of Work in the existing building and becomes a part of each Section and Division performing remodeling, removal and relocation Work for this Project with the same force and effect as if written in full therein.
- B. Take all necessary precautions to keep students and other trespassers out of the Work areas. Secure Work areas from entry when Work is not in progress.
- C. Perform all alterations, remodeling, demolition, removal and relocation of Work in strict accordance with Owner's instructions and applicable Federal, State and local health and safety standards, codes and ordinances. Where conflicts occur, the more restrictive requirement shall govern.
- D. Refer to section 01 71 50 Preventive Housekeeping and Final Carpet Cleaning.

1.2 RELATED WORK

- A. Section 02 41 01 - Demolition

1.3 EXISTING CONDITIONS

- A. Obvious existing conditions, installations and obstructions affecting the Work shall be taken into consideration as necessary Work to be done, the same as though they were completely shown or described.
- B. Items of existing construction indicated to remain upon completion of the Contract, but which require removal to complete the Work, shall be carefully removed and replaced as required. The replaced Work shall match its condition at the start of the Work unless otherwise required.
- C. Visit the site to determine by inspection all existing conditions, including access to the site, the nature of structures, objects and materials to be encountered, and all other facts concerning or affecting the Work. Information on the Drawings showing existing conditions does not constitute a guarantee that other items may not be found or encountered.
- D. Utilities: Do not interrupt existing utilities serving occupied or used facilities, except when authorized by the Architect/Owner in writing two (2) weeks in advance. Provide temporary services during interruptions to existing utilities.

PART 2 - PRODUCTS

2.1 SALVAGED MATERIALS

- A. The Owner reserves the right of first refusal on all salvage items. Remove remaining items from the site as Work progresses. Storage or sale of items on site is not permitted. Burning or burying of removed materials on site is not permitted.
- B. Store salvaged items in a dry, secure place on site.

- C. Salvaged items not required for use in repair of existing Work shall remain the property of the Owner.
- D. Do not incorporate salvaged or used material in new construction except where specified in the Contract Documents

2.2 PRODUCTS FOR PATCHING, EXTENDING AND MATCHING

- A. Contract Documents do not define products or standards of workmanship present in existing construction. Determine products by inspection and by use of the existing. Provide same or similar quality products or types of construction as that in existing structure when needed to patch or extend existing Work.
- B. If reasonably matching products are not obtainable, improve appearance by minor relocating of some existing products and grouping new ones in some pattern arranged by the Architect.

PART 3 - EXECUTION

3.1 PROTECTION OF WORK TO REMAIN

- A. Protect existing Work from damage. Use barricades, tarpaulins, temporary walls, plywood, planking, masking, or other suitable means and methods as approved by the Architect.
- B. If Work to remain in place is damaged, restore to original condition at no additional cost to the Owner.
- C. Concealed Conditions: If conditions cause changes in the Work from requirements of the Contract Documents, the Contract Sum will be adjusted in accordance with the General Conditions.

3.2 PROCEDURES

- A. Refinishing At Removed Work: Cut below surface of substrate materials and patch over area of removal with finish materials so removal is not apparent.
- B. Remove and replace existing ceilings, and cut, patch, or replace existing walls, partitions and floors as may be necessary for access to valves, piping, conduit and tubing by mechanical and electrical trades as directed and approved by the Architect, and performed by the appropriate subcontractor for the Work involved, or by other properly qualified subcontractors.
- C. Patch and extend existing Work using skilled mechanics who are capable of matching existing quality and workmanship. Quality of patched or extended Work shall be not less than that specified for new Work.
- D. Cutting:
 - 1. Concrete and Masonry: Saw cut where feasible.
 - 2. Plaster: Cut back to sound plaster on straight lines, and back-bevel edges of remaining plaster. Trim and prepare existing lath for tying of new lath.
 - 3. Woodwork: Cut back to a joint or panel line. Undamaged removed materials may be reused.
 - 4. Resilient Tiles: Remove in whole units to natural breaking points or straight joint lines with no damaged or defective existing tiles remaining where joining new construction.
 - 5. Salvaged Materials: Carefully remove to avoid damage, thoroughly clean and reinstall as indicated, or as directed.
 - 6. Doors: Remove in such a manner as to facilitate filling in of openings or installation of new Work, as required by Drawings. **Refer to Finish Hardware Section for specific requirements for salvage of existing finish hardware.** Provide construction cores as required to maintain security and access control.

7. Structural Elements: Remove only as shown on the Structural Drawings. If not specifically shown, but removal is required, perform such removal or alteration only upon written approval of the Architect. Do not damage or alter any structural element of the existing building.
- E. Patching:
 1. Match existing Work where possible; if unavailable, use salvage material for patching and provide totally new material in areas where salvage has been removed; consult with the Architect concerning locations for salvaging materials.
 2. Repairs or continuations of existing Work shall be relatively imperceptible in the finished Work when viewed under finished lighting conditions from a distance of six (6) feet.
 3. Patching, Repairing and Finishing of Existing Work: Perform in compliance with the applicable requirements of the Specification Section covering the Work to be performed and the requirement of this Section.
- F. Erect scaffolding as necessary to gain access to the various parts of the Work. Provide structurally sound, rigidly braced and properly constructed scaffolding, shoring, and bracing as necessary to positively protect the affected elements and building, and to support the activities or workmen and loads. Design and construction of scaffolds and supports shall be in accordance with applicable safety regulations. Material used shall be adequate to support anticipated loads with a properly calculated margin of safety.
- G. Noise Producing Equipment: Minimize use of noise producing equipment. Limit excessive noise to periods of vacancy or provide sound control. Arrange schedules in advance with the Architect and Owner.

3.3 EXISTING FURNITURE AND EQUIPMENT

- A. Owner Salvaged Items: Personal items in areas subject to remodeling will be removed by Owner before construction in those areas commences. Contractor shall notify Owner if any personal items remain; Owner shall remove such items.
- B. Furniture Items - Renovation: Contractor shall be responsible for any furniture relocation, storage, and move-back necessary to complete scope of work. Contractor to coordinate activities with Owner. Contractor is solely responsible for protecting furniture and equipment and is therefore solely responsible for any damage to said items and ensuing costs in restoring damaged items to same condition or replacing lost or damaged items beyond repair, unless specified as an allowance (Section 01 21 00).

3.4 PAINTING

- A. Preparation: Prepare patched areas as required for new Work. Wash existing painted surfaces with neutral soap or detergent, thoroughly rinse, and sand when dry.
- B. Painting and Finishing: Conform to the applicable provisions of the Painting Section. Prepare bare areas and patches in existing painted surfaces with specified primer and intermediate coats, sanded smooth and flush with adjoining surfaces.

3.5 DISPOSAL OF DEBRIS

- A. Remove daily material, debris and rubbish resulting from Work of this Section from the building and site as it accumulates. Keep all areas of Work in "broom clean" condition as the Work progresses.

3.6 JOB SUPERINTENDENT

- A. If renovation project includes Work at more than one site, Contractor shall have supervision at all

sites as follows:

Cy Ridge HS shall have at least one full-time Superintendent.

Cy Ridge HS shall have at least one full-time Assistant Superintendent.

3.7 FINAL CLEANING

- A. At completion of renovation and remodeling Work in each area, provide final cleaning of all surfaces and return all areas affected by construction to a condition suitable for use by the Owner. Final cleaning shall include dusting of all surfaces; thorough cleaning of all surfaces including the removal of smudges, marks, stains, fingerprints, soil, dirt, paint spots, lint, discolorations, and other foreign materials; vacuuming of carpets; cleaning of all new carpeting by manufacturer-approved contractor; wet-mop cleaning of tile, and waxing of VCT, terrazzo surfaces per CFISD-approved methods. Refer to section 01 71 50 for Preventive Housekeeping and Final Carpet Cleaning.

END OF SECTION

SECTION 01 36 13.1

CUTTING AND PATCHING

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Execute cutting (including excavating and backfilling), fitting or patching of the work, required to:
 - 1. Make several parts fit properly.
 - 2. Uncover work to provide for installation of ill-timed work.
 - 3. Remove and replace defective work.
 - 4. Remove and replace work not conforming to requirements of the contract documents.
 - 5. Remove samples of installed work as specified for testing.
 - 6. Install specified work in existing construction.
- B. In addition to contract requirements, upon written instruction of the Architect:
 - 1. Uncover work to provide for observation of covered work.
 - 2. Remove samples of installed materials for testing.
 - 3. Remove work to provide for alteration of existing work.
- C. Do not endanger any work by cutting or altering the work or any part of it.
- D. Do not cut or alter the work of another Contractor without written consent of the Architect.
- E. Prior to cutting that affects structural safety of the project or the work of another Contractor, secure written approval of the Architect.

1.2 PAYMENT FOR COSTS

- A. Costs caused by ill-timed or defective work or work not conforming to the contract documents, including the cost of additional services of the Architect, Third-Party Consultants, and Owner, will be borne by the Contractor.
- B. Work done on written instructions of the Owner or Architect, other than defective or nonconforming work, will be paid by the Owner.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Materials required for replacement of the work removed must conform to the specifications for the type of work to be done.

PART 3 - EXECUTION

3.1 PREPARATION:

- A. Provide shoring, bracing and support as required to maintain the structural integrity of the project.
- B. Provide protection for other portions of the project.
- C. Provide protection from the elements.

3.2 PERFORMANCE

- A. Execute fitting and adjustment of products to provide finished installation to comply with specified tolerances and finishes.
- B. Execute cutting and demolition by methods which will prevent damage to other work and will provide proper surfaces to receive installation of repairs and new work.
- C. Execute excavation and backfilling by methods which will prevent damage to other work and will prevent settlement.
- D. Restore work which has been cut or removed; install new products to provide complete work in accordance with requirements of the contract documents.
- E. Refinish entire surfaces as necessary to provide an even finish. On continuous surfaces, refinish to the nearest intersections. For an assembly, refinish the entire item.

END OF SECTION

SECTION 01 45 00

QUALITY CONTROL

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Quality Assurance: Requirements for material and product quality and control of installation
- B. Tolerances
- C. References and Standards
- D. Mock-ups
- E. Testing Laboratory Services
- F. Inspection Services
- G. Manufacturers' field services

1.2 RELATED SECTIONS

- A. Section 01 41 00 - Regulatory Requirements
- B. Section 01 45 23 - Testing and Inspecting Services
- C. Section 01 33 00 - Submittal Procedures
- D. Section 02 32 00 - Geotechnical Report
- E. The work of this Section shall be included as a part of all Sections of work, whether referenced therein or not.

1.3 DESCRIPTION OF REQUIREMENTS

- A. Unless specifically noted otherwise, perform all work shown, mentioned, or reasonably inferred and comply with all work restrictions.
- B. Many of the requirements specified elsewhere are included herein for reference and convenience. Where a conflict occurs between the Contract Documents, either within themselves or each other, the more stringent requirement or the most expensive combination of materials and workmanship shall prevail.
- C. Contractor shall:
 - 1. Perform work in accordance with the General Conditions, as specified herein, and with the quality control requirements of each Specification Section.
 - 2. Perform work in the highest quality workmanship, unless specified otherwise.
 - 3. Join materials with a uniform and accurate fit so they meet with neat straight lines, free of smears, overlaps or irregularities, as applicable to the work.
 - 4. Install all exposed materials appropriately level, plumb, and at accurate angles as shown and flush with adjoining materials.

5. Attach materials with sufficient strength, and with number and spacing of fasteners and attachments that will not fail until materials joined are broken or permanently deformed.
6. Use concealed fasteners, unless shown or directed otherwise.

1.4 QUALITY ASSURANCE AND CONTROL OF INSTALLATION

- A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce work of specified quality.
- B. Comply with manufacturers' instructions, including each step in sequence.
- C. Should manufacturer's instructions conflict with Contract Documents, request clarification from Architect/Engineer before proceeding.
- D. Comply with specified standards as minimum quality for the work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Perform work by persons qualified to produce required and specified quality.
- F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.
- G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.

1.5 TOLERANCES

- A. Monitor fabrication and installation tolerance control of products to produce acceptable work. Do not permit tolerances to accumulate.
- B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Architect/Engineer before proceeding.
- C. Adjust products to appropriate dimensions; position before securing products in place.

1.6 REFERENCES AND STANDARDS

- A. For products or workmanship specified by association, trade, or other consensus standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- B. Conform to reference standard by date of issue current on date of Owner-Contractor Agreement except where specific date is established by code.
- C. Obtain copies of standards where required by product specification sections.
- D. When specified reference standards conflict with contract documents, request clarification from Architect/Engineer before proceeding.
- E. Neither contractual relationships, duties, responsibilities of parties in contract nor those of Architect/Engineer shall be altered from contract documents by mention or inference otherwise in reference documents.
- F. Refer to Section 01 41 00, Codes, Regulations and Standards, for additional information concerning applicable reference and standards requirements.

1.7 MOCK-UP REQUIREMENTS

- A. Tests will be performed under provisions identified in this section and identified in respective product specification sections.
- B. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.
- C. Accepted mock-ups shall be the comparison standard for remaining work.
- D. Where mock-up has been accepted by Architect/Engineer and is specified in product specification sections to be removed; remove mock-up and clear area when directed to do so by Architect.
- E. Mock-up may be approved in phases as portions are completed.
- F. Project Mock-up Requirements: Provide an actual sample mockup wall with multiple panels with the following properties:
 - 1. Size: Minimum 8 feet wide by 8 feet tall. Size may vary according to specific project requirements. Brace and support as required to withstand structural windloads.
 - 2. Materials: actual exterior finishes including, but not limited to face brick, cast stone, and plaster, actual building materials and assemblies indicating brick patterns on masonry and stud back-up as occurs with dampproofing and flashing as detailed, actual portion of aluminum storefront indicating jam, sill and head attachment and flashing details, and where appropriate, provide mock-up of special finish details, insets and reliefs, reveals, expansion and control joints, brick ledges, brick head and sills, pipe penetrations and waterproofing materials. Provide roof edge flashing and gutter section (as applicable) in pre-finished color as selected by Architect to cap the mock-up panel. Include a sealant joint at least 16 inches long. Brick and Mortar color shall be selected by Architect prior to mock-up assembly.
 - 3. Drawing: Refer to mock-up diagram on Drawings for minimum project requirements. Mock-up drawing is for reference only. Actual mock-up drawing will be submitted by the Architect after submittals have been approved.

1.8 TESTING SERVICES

- A. Owner will appoint, employ, and pay for specified services of an independent firm to perform testing.
- B. The independent firm will perform tests and other services specified in individual specification sections and as required by the Architect/Engineer, Owner, or authority having jurisdiction.
- C. Testing and source quality control may occur on or off the project site. Perform off-site testing as required by the Architect/Engineer or the Owner.
- D. Reports will be submitted by the independent firm to the Owner, Architect/Engineer, and Contractor, indicating observations and results of tests and indicating compliance or non-compliance with Contract Documents.
- E. Cooperate with independent firm; furnish samples of materials, design mix, equipment, tools, storage, safe access, and assistance by incidental labor as requested.
 - 1. Notify Architect/Engineer and independent firm 48 hours prior to expected time for operations requiring services, or as specified in individual specification sections.
 - 2. Make arrangements with independent firm and pay for additional samples and tests required.
- F. Testing does not relieve Contractor to perform work to contract requirements.

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- G. Re-testing required because of non-conformance to specified requirements shall be performed by the same independent firm on instructions by the Architect/Engineer. Payment for re-testing will be charged to the Contractor by deducting testing charges from the Contract Sum/Price.
- H. Refer to Section 01 45 29, Inspection and Testing Laboratory Services, for additional information concerning testing, and submittal procedures and requirements for Testing Reports.

1.9 INSPECTION SERVICES

- A. Owner will appoint, employ, and pay for specified services of an independent firm to perform inspection.
- B. The independent firm will perform inspections and other services specified in individual specification sections and as required by the Architect/Engineer, Owner, or authority having jurisdiction.
- C. Inspecting may occur on or off the project site. Perform off-site inspecting as required by the Architect/Engineer or the Owner.
- D. Reports will be submitted by the independent firm to the Owner, Architect/Engineer, and Contractor, indicating inspection observations and indicating compliance or non-compliance with Contract Documents.
- E. Cooperate with independent firm; furnish safe access and assistance by incidental labor as requested.
 - 1. Notify Architect/Engineer and independent firm 48 hours prior to expected time for operations requiring services, or as specified in individual specification sections.
- G. Inspecting does not relieve Contractor to perform work to contract requirements.
- H. Refer to Section 01 45 29, Inspection and Testing Laboratory Services, for additional information concerning inspections, and submittal procedures and requirements for Inspection Reports.

1.10 MANUFACTURERS' FIELD SERVICES

- A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust and balance of equipment as required, and to initiate instructions when necessary.
- B. Submit qualifications of observer to Architect/Engineer within ten (10) days after receipt of Notice to Proceed, in advance of required observations. Observer subject to approval of Architect/Engineer and Owner.
- C. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.
- D. Refer to Section 01 33 00, Submittal Procedures, for additional information concerning submittal procedures and requirements for Manufacturers Field Reports.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify existing site conditions and substrate surfaces are acceptable for subsequent work. Beginning new work means acceptance of existing conditions.
- B. Verify existing substrate is capable of structural support or attachment of new work being applied or attached.
- C. Examine and verify specific conditions described in individual specification sections.
- D. Verify utility services are available, of correct characteristics, and in correct locations.

3.2 PREPARATION

- A. Clean substrate surfaces prior to applying next material or substance.
- B. Seal cracks or openings of substrate prior to applying next material or substance.
- C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying new material or substance in contact or bond.

END OF SECTION

SECTION 01 45 29

INSPECTION AND TESTING LABORATORY SERVICES

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 DESCRIPTION (refer to Document AB for substitutions).

- A. All third-party inspection and testing laboratory services will be provided and paid for by the Owner or by allowance in this contract. An inspection and testing lab will be selected by the Owner and the Contractor will be notified as soon as possible.
- B. The Owner will pay for the initial inspection and testing laboratory services of materials that comply with the requirements of the Contract Documents. The Contractor shall pay for re-inspection and re-testing of materials that do not comply with the requirements of the Contract Documents, and for re-inspection and re-testing due to “no-shows” and cancellations by Contractor or Subcontractors.
- C. The Contractor shall coordinate and cooperate with the inspection and testing laboratory in all matters pertaining to the work. The Owner retains the option to add to or delete any or all inspection and testing specified herein.
- D. The third-party inspection and testing laboratory services are for the Owner’s benefit. These services shall in no way relieve Contractor of Contractor’s responsibility to provide quality control of all materials incorporated into the Work.
- E. Contractor may be subject to reimbursing owner if the Contractor’s means and methods are shown to cause an overrun in the Owner’s contract with testing lab.
- F. Prior to or during the pre-construction meeting, Contractor shall coordinate with the District’s selected testing lab in order to ensure proposal costs are not exceeded and schedule is congruent to testing proposed. Failure to coordinate may result in backcharges if overages are realized.
- G. Contractor shall submit a construction schedule at time of bid for the testing lab’s use.
- H. Contractor shall allow for in their proposal the coordination and supervision of tests to be performed by an independent laboratory as selected by the Owner.

1.2 RELATED REQUIREMENTS

- A. Conditions of the Contract: Inspections and testing required by laws, ordinances, rules, regulations, orders or approvals or public authorities.
- B. Respective Sections of Specifications. Certification of products.
- C. Each Specification Section Listed: Inspection and laboratory test required and standards for inspection and testing.
- D. Testing laboratory inspection, sampling and testing are required for, but not limited to the following:
 - 1. Division 31 - Earthwork
 - 2. Section 03 30 00 - Cast-In-Place Concrete
 - 3. Section 05 31 23– Steel Roof Decking
 - 4. Section 04 20 00 - Unit Masonry
 - 5. Section 05 12 00 - Structural Steel
 - 6. Section 07 52 19 - Modified Bituminous Membrane Roofing System

7. Division 23 - Mechanical (Inspection and testing of welds and bolts on mechanical piping)
As requested by the Owner, Architect, or Engineer.

1.3 AUTHORITIES AND DUTIES OF THE LABORATORY

- A. The inspection and testing laboratory is not authorized to revoke, alter, relax, enlarge, or release any requirement of the Specifications, or to approve or accept any portion of the Work. When it appears that the material furnished or work performed by the Contractor fails to fulfill specification requirements, the inspection and testing laboratory shall promptly notify the Owner, General Contractor, Architect, Engineers, supplier and/or subcontractor providing or preparing the materials or work being tested of such deficiencies.
- B. The inspection and testing laboratory shall promptly distribute copies of the laboratory test and inspection reports. Standard distribution shall include copies of all reports to the Owner, Architect, and General Contractor. The Structural Engineer, Civil Engineer, MEP Engineer, concrete supplier, and any outside consultants shall receive copies of the testing results regarding their particular phase of the Project. Consult with Owner to determine Owner's preference of distribution (hard copy, electronic, etc.).
- C. The testing laboratory shall provide testing services under a separate agreement with the Owner or Architect, who shall be responsible for the costs of initial testing – pass or fail.
 1. The Contractor shall be responsible for costs of all re-tests required to achieve passing results.
 2. The Contractor shall be responsible for charges of the testing lab for expenses incurred for cancelled and/or mis-scheduled testing requests.
 3. The testing lab shall invoice Contractor direct for all re-tests of failed initial tests; and send copies of the invoices to the Architect and Owner for record.
 4. The testing lab and Contractor shall be responsible to negotiate and execute a separate agreement if required by the testing lab for charges described above.
- D. The testing lab is required to furnish a report of the status of testing performed as it relates to anticipated expenses described in the Agreement with the testing lab. Reports shall be furnished at most bi-monthly to the Owner and Architect.
 1. Report information shall include verification that Owner paid testing progress corresponds with anticipated expenses.
 2. The testing lab shall be required to notify the Architect and Owner immediately in writing if/when the testing lab anticipates exceeding the line item and or lump sum fee agreed by Owner.
 3. Such notification must occur prior to expensing 75% of the testing lab fee.

1.4 TESTING LABORATORY GUIDELINES AND PROCEDURES

- A. Technicians scheduled to perform specific inspection and testing services must be qualified to review and perform other services that overlap, i.e., earthwork, foundation inspections, rebar inspection, and concrete when scheduled concurrently at the Project site.
- B. Concrete design mixes will receive a cursory review with any discrepancies reported to the Architect/Engineer. No compensation will be considered for these reviews.
- C. Nuclear density testing will be based on a daily rental rate for the actual testing equipment, compensation on a per test basis will not be considered.
- D. Report distribution shall include the Owner, Architect, Contractor, Civil Engineer, Structural Engineer, and others requesting or requiring review of the specific testing results.

- E. Cylinders will be pick-up by the technician performing test the next day in order to have them cure under laboratory conditions.
- F. Structural steel inspections shall include a plant visit reviewing shop fabrication, welding, and an overall review of the shop fabrication quality control standards.
- G. The Contractor shall bear the responsibility of scheduling all the inspection and testing services. The Contractor and the testing laboratory shall assume full responsibility to coordinate the inspection and testing services. Cancellations and or failed test will be reimbursable to the Owner by the Contractor. Contractor will provide and maintain a sign-in sheet for testing lab services.
- H. Technician time for services performed will be reimbursed at a regular time rate. Compensation at the overtime rate will be considered for any hours over eight hours spent at the job site on a single day, field testing services performed on a Saturday or Sunday, and any field services performed on a recognized holiday.

PART 2 - PRODUCTS

Not Used

PART 3 – EXECUTION

3.1 GENERAL

- A. Inspection and testing services shall include, but not be limited to those specified below or which are necessary or required during course of construction to ascertain specification compliance and which may be deemed necessary by Architect, Engineer, or Owner to ensure the quality of the Work.
- B. Where requirements of this Section are in conflict with requirements noted on the Contract Drawings or other Sections of the Specifications, the more stringent requirement shall apply, unless directed otherwise by Architect.
- C. Should any unusual conditions be encountered during any operations, the laboratory shall be contacted immediately so that additional inspection and testing, as applicable, can be provided.
- D. The Owner reserves the right to add to or delete any or all inspection and testing specified herein.

3.2 SITE GRADING

- A. Testing Services:
 - 1. Perform field tests for moisture density properties.
 - a. In each compacted fill layer, provide one (1) field test for every 5,000 square feet of area, but not less than three (3) tests.
 - b. At paved area, provide one (1) field test for every 5,000 square feet, but not less than three (3) tests.

3.3 COMPACTING FILL AND BACKFILL

- A. Testing Services:
 - 1. Perform field test for moisture density properties:
 - a. Within the building line provide one (1) field test in each compacted layer for every 5,000 square feet of area, but not less than three (3) tests.

3.4 PAVING

- A. Testing Services:
 - 1. Perform field tests for moisture density properties:
 - a. Provide field testing of the sub-grade as described in Paragraph 3.2, A, 2 above.
 - b. Paving sub-base, provide one (1) field test for every 5,000 square feet of area of crushed limestone or caliche sub-base, if any.
 - c. Lime treated sub-grade, provide one (1) field test for every 5,000 square feet of area of lime treated sub-grade, if any, for content of lime and sub-grade compaction.
 - d. Cement soil stabilization, if any, provide one (1) field test for every 5,000 square feet of area of cement stabilized sub-grade for content of cement and sub-grade compaction.

3.5 PIPED SITE UTILITIES

- A. Inspection and Observation Services:
 - 1. Inspection of trenches for proper alignment and grade.
 - 2. Inspection of pipe bedding and supports.
 - 3. Inspection of pipe, joints, jointing material, and thrust blocks prior to installation of pipe.
 - 4. Inspection of installation of pipe and joints.
 - 5. Observation of testing of piped utilities performed by Contractor.

3.6 EARTHWORK

- A. Inspection and Observation Services:
 - 1. Refer to and include, as applicable, work of Paragraphs 3.2, 3.3, 3.4, and 3.5 above.
 - 2. When perimeter and underfloor drainage systems are specified or required, inspect installation of such systems for conformance with specified materials and detail requirements.
 - 3. When temporary drainage and dewatering systems are used to keep excavations dry, inspect the systems for adequacy. Ground water should be maintained at least two (2) feet below bottom of excavation.
 - 4. Review the equipment and methods used in placement and compaction of fill materials and inspect materials used and compaction of fills in general earthwork and in backfilling around structures, and in backfilling in utility trenches.
 - 5. Notify the Contractor in writing and the Architect/Owner immediately if footings and slabs-on-grade are placed on unfinished soil or frozen ground and when footings and slabs-on-grade are not protected from frost damage.
 - 6. Notify the Architect/Owner when soil with allowable bearing capacity noted is encountered at elevation above the bottom of footing shown.
 - 7. Notify the Architect/Owner and Contractor if soil with required bearing capacity noted is not encountered at bottom of footing elevation shown. Bottom of footing shall be adjusted as recommended and approved by the Structural Engineer and Architect.
 - 8. Review rock excavation techniques, if required, and monitor blasting induced ground motions, as appropriate.
 - 9. Review calculations and shop drawings for sheeting, shoring, and underpinning prepared by the Contractor, if required.
- B. Testing Services:
 - 1. References (As applicable for tests):
 - a. ASTM International (ASTM)
 - 1) D698, Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft³ (600 kN-m/m³))
 - 2) D2922, Standard Test Method for Density of Soil and Soil-Aggregate In Place By Nuclear Methods (Shallow Depth)
 - 3) D4318, Liquid Limit, Plastic Limit, and Plasticity Index of Soils

- b. American Association of State Highway and Transportation Officials (AASHTO)
 - 1) T89, Determining the Liquid Limit of Soils
 - 2) T90, Determining the Plastic Limit and Plasticity Index of Soils
 - 3) T99, Moisture-Density Relations of Soils Using a 2.5 kg (5.5 lb.) Rammer and a 305-mm (12-in) Drop
 - 4) T238, Density of Soil and Soil Aggregates In Place By Nuclear Methods (Shallow Depth)
 2. Perform sieve analysis to develop grain size distribution curves for materials to be used for subgrade, fill under slab-on-grade, and backfills.
 3. Establish the moisture density relation of soils to be used as fill using the method best suited to the type of fill material.
 4. Determine moisture content of all fill materials before placement and advise Contractor when it is or is not suitable to achieve required compaction.
 5. Determine Liquid Limit in accordance with ASTM D4318 or AASHTO T89, Plastic Limit in accordance with ASTM D4318, and Plasticity Index in accordance with ASTM D4318 of all fill material.
 6. Perform one (1) in place density test for each 2,500 square feet (280 square yards) of existing subgrade material.
 7. Perform Moisture-Density curve in accordance with ASTM D698 or AASHTO T99 for one (1) type of fill material. If the original choice of material does not meet the specifications, the Contractor shall pay for additional testing.
 8. Perform in place density tests of each lift of compacted fill at locations adequate to evaluate the degree of compaction of all fill areas. Conduct one (1) test for each 2,500 square feet (280 square yards) of each lift of compacted fill.
- C. Reports: Submit reports to Architect/Owner with the following information:
1. Type and condition of soil at footing bottoms.
 2. Level of water table in the excavated areas.
 3. Grain size distribution of fill materials (average of three (3) tests).
 4. Moisture density test results.
 5. In place density test results with moisture content and relative density of each layer of compacted fill. Include with in place density test results, a plan showing location of each test.
 6. Notify Architect/Owner by telephone within one (1) hour of the discovery of the following conditions and follow up telephone notification with written report.
 - a. Materials used, or degree of soil compaction not meeting specified requirements.
 - b. Frost and freeze protection requirements for excavation bottoms not being complied with.
 - c. Water in excavations which is not being removed prior to work being performed in excavation.

3.7 DRILLED AND UNDERREAMED (BELLED) PIERS

- A. Inspection and Observation Services:
1. Provide full time services for the review of all drilled pier foundation inspections. Including a daily report noting grid lines and locations of each pier drilled. After the foundation shaft has been drilled, the lab shall test an undisturbed sample and verify that it meets or exceeds the design specification.
 2. The drilling and verification of suitable soil for bearing capacity. Notify the Architect when soil with allowable bearing capacity noted is encountered at elevation above the bottom of pier shown. Notify the Architect and Contractor if soil with required bearing capacity noted is not encountered at bottom of pier elevation shown. Bottom of pier shall be adjusted as recommended and approved by the Structural Engineer and Architect.
 - a. Drilled shaft has been drilled plumb and within specified vertical and horizontal tolerances specified by the Structural Engineer.

- b. Drilled shaft and underreamed bells are excavated to specified depths and/or if conditions differ from those presented, to notify the Structural Engineer.
- c. Drilled shaft and underreamed bell bottoms are kept dry at all times, cleaned of excess cuttings, or all obstructions prior to placing reinforcing steel and concrete. If groundwater seepage occurs, it shall be removed prior to concrete placement or controlled with temporary steel casing to maintain the shaft integrity up to the concrete placement.
- d. Concrete reinforcing steel shall be checked for type, size, adequate placement and lap lengths, and doweled bars.

3.8 CONCRETE REINFORCING STEEL AND EMBEDDED METAL ASSEMBLIES

A. Inspection and Observation Services:

- 1. Inspect all concrete reinforcing steel prior to placing of concrete for compliance with Contract Documents and approved shop drawings. All instances of noncompliance with Contract Documents and approved shop drawings shall be immediately brought to the attention of the Contractor for correction and then, if uncorrected, reported to the Architect/Owner.

B. Reports:

- 1. Observe and Report on the Following:
 - a. Number and size of bars.
 - b. Bending and lengths of bars.
 - c. Splicing.
 - d. Clearance to forms including chair heights.
 - e. Clearance between bars or spacing.
 - f. Rust, form oil, and other contamination.
 - g. Grade of steel.
 - h. Securing, tying, and chairing of bars.
 - i. Excessive congestion of reinforcing steel.
 - j. Installation of anchor bolts and placement of concrete around such bolts.
 - k. Fabrication of embedded metal assemblies, including visual inspection of all welds.
 - l. Visually inspect studs and deformed bar anchors on embedded assemblies for compliance with 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 or bar, such stud or bar shall be struck with a hammer and bent 15 degrees off perpendicular and then bent back into position. Anchors failing this test shall be replaced.

C. Testing Services:

- 1. Will be required of all suspect materials or workmanship at the discretion of the Architect, Engineer, or Owner.

3.9 REINFORCING STEEL MECHANICAL SPLICES

A. Inspection and Observation Services:

- 1. Visually inspect and report on the completed condition of each mechanical splice of reinforcing steel.
- 2. Each mechanical splice shall be visually inspected to ensure compliance with the I.C.B.O. reports and the manufacturer's published criteria for acceptable completed splices.
- 3. Special emphasis shall be placed on inspection of the end preparation of each bar to be spliced, as required by the I.C.B.O. Report.

- B. Reports: Submit reports to Architect with the following information:
1. Submit copies of manufacturer's published criteria for acceptable completed splices prior to observing mechanical splices.
 2. Reports on each mechanical splice shall indicate location of the splice, size of bars spliced, and acceptability or rejection of splice. Reasons for rejection shall be shown on each report.

3.10 CAST-IN-PLACE CONCRETE

- A. Inspection and Observation Services:
1. Review concrete design mixes proposed for use on the Project.
 2. Provide full time services for all structural building concrete in drilled piers, grade beams, slab on grade, columns, concrete paving, and other miscellaneous structural concrete. Refer to and include work for reinforcement steel specified in Paragraphs 3.8 and 3.9 above.
 3. On the first day's batching of each type and each strength of concrete, inspect and observe materials for concrete, batch weights, moisture content, and gradation of fine and coarse aggregate.
 4. Provide additional inspection if the Contractor elects to use concrete from more than one (1) source of supply simultaneously. All costs for such additional inspection shall be borne by the Contractor.
- B. Testing Services:
1. References (As applicable for field and laboratory tests):
 - a. American Concrete Institute (ACI)
 - 1) 214, Recommended Practice for Evaluation of Strength Test Results of Concrete
 - 2) 318, Building Code Requirements for Reinforced Concrete
 - b. ASTM International (ASTM)
 - 1) C31, Practice for Making and Curing Concrete Test Specimens in the Field
 - 2) C39, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
 - 3) C138, Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete
 - 4) C143, Slump of Hydraulic Cement Concrete
 - 5) C173, Air Content of Freshly Mixed Concrete by the Volumetric Method
 2. Compression Test Cylinders:
 - a. Make, transport, cure and test six (6) inch or (4) inch diameter by 12-inch-long test specimens taken from concrete being cast. Test cylinders will be made, handled, cured, and stored in accordance with ASTM C31, at the rate of four (4) cylinders minimum for each 50 cubic yards slab on grade or elevated slab four (4) cylinders minimum for each 100 cubic yards paving or fraction thereof of each class of concrete placed in any one (1) day.
 - b. Handle newly made cylinders carefully to avoid cracking the green concrete. Store these cylinders in a box at temperatures between 60 degrees F and 80 degrees F during first 24 hours. Contractor shall construct a suitable box and provide heat or cooling, if necessary, to maintain cylinders at proper temperature.
 - c. Place cylinders in laboratory storage, with molds removed, under moist curing conditions and temperature of 73 degrees plus or minus three (3) degrees F 24 hours after casting maintain these moist curing conditions until specimens are tested.
 - d. Of the test cylinders taken per 50 cubic yards or fraction thereof, test one (1) at seven (7) days and two (2) at 28 days after casting date. Store one (1) cylinder for testing at 56 days in the event the 28 days strength tests do not meet strength requirements. Test cylinders in accordance with ASTM C39. When Type III cement is used, test at three (3) days instead of seven (7) days.

- e. Each 28-day compression test report shall clearly indicate average strength results, concrete slump and air content, concrete and ambient air temperatures, and how much water was added on site by contractors as of the report date and for the class of concrete being reported.
 - f. Maintain a moving average for compressive strength based on the three (3) latest 28-day test results to check compliance with specification requirements. The figures for the standard deviation and moving average for strength will be kept continuously up to date and submitted on a weekly basis to the Architect and Engineer. Maintain a continuously up to date log in both graphical and tabulated form for each class of concrete.
 - 1) the average of the latest three (3) test results;
 - 2) the lowest average of three (3) consecutive test results recorded to date;
 - 3) the average of all sets of three (3) consecutive test results;
 - 4) the percentage of tests falling below specified strength;
 - 5) the lowest single test result.
 - g. Maintain a moving average for range of test results for quality control purposes as described in ACI 214, Chapter 4, Paragraphs 4.4 and 4.5. Graphical reports of moving average for range shall be submitted to the Architect and Engineer on a weekly basis.
 - h. Slump Tests: Conduct in accordance with ASTM C143; one (1) test shall be performed for each sampling for strength tests. Slump shall be considered acceptable if the field test is within the range of design slump plus or minus one (1) inch. For concrete placed by pumping, one (1) test shall be performed at the pump and one (1) at the point of deposit. Slump loss through pumping will be acceptable to the Architect and Engineer. Slump measured at the pump shall be evaluated for acceptance relative to the design slump in accordance with the criteria previously specified.
 - i. Air Content Tests: Conduct in accordance with ASTM C173; test air entrained concrete only, one (1) test shall be performed for each sampling for strength tests. Air content shall be considered acceptable if the field test is in the range of the design air content plus two (2) percent.
 - j. Unit Weight Tests: Conduct in accordance with ASTM C138; test each sample of lightweight concrete taken for strength tests. Unit weight shall be considered acceptable if the field test shows a fresh unit weight equal to the design unit weight plus or minus 2 pcf.
 - k. Chloride Tests: Perform one (1) total chloride ion test for each class of concrete placed each day. If the total chloride ion content is determined to be excessive by the Architect or Engineer, water soluble chloride ion tests shall be performed at the Contractor's expense.
3. Noncompliance: In the event the initial tests above indicate that concrete may not meet the specified requirements, the Architect or Engineer may, at his discretion, order additional tests be performed at the Contractor's expense. Load tests shall comply with requirements of ACI 318.

3.11 MASONRY

- A. Inspection and Observation Services:
 - 1. Inspection of placement of reinforcement including condition, grade, size, location, spacing, and lap splices.
 - 2. Review mortar design mixes.
 - 3. Inspection of laying, mortaring, and grouting of concrete masonry units and elements.
- B. Testing Services:
 - 1. References (As applicable for tests required):
 - a. ASTM International (ASTM)

- 1) C140, Standard Test Methods of Sampling and Testing Concrete Masonry Units
 - 2) C780, Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry
 - 3) C1019, Standard Test Method for Sampling and Testing Grout
 - 4) E447, Standard Test Methods for Compressive Strength of Laboratory Constructed Masonry Prisms
2. Testing of Concrete Masonry Units (CMU):
- a. Preconstruction: Perform the following tests in accordance with ASTM C140.
 - 1) Compressive Strength
 - 2) Absorption
 - 3) Weight
 - 4) Moisture Content
 - 5) Dimensions
3. Mortar Tests:
- a. Preconstruction: Perform the following tests in accordance with ASTM C780 on each type of mortar mix used on the Project.
 - 1) 28 Day Compressive Strength
 - 2) Water Retention
 - b. Construction: Perform 28-day compressive strength test in accordance with ASTM C780 on each type of mortar mix used on the Project at the rate of one (1) test per 2,000 square feet of masonry.
4. Refer to and include work for reinforcing steel specified in Paragraphs 3.5 and 3.6 above.
5. Grout Tests:
- a. Preconstruction: Perform the following tests in accordance with ASTM C1019 on each type of grout mix used on the Project.
 - 1) Slump Test
 - 2) 28 Day Compressive Strength
 - 3) Construction: Perform 28-day compressive strength test in accordance with ASTM C1019 on each type of grout mix used on the Project at the rate of one (1) test per 2,000 square feet of masonry.
 - 4) Prism Test: Perform preconstruction 28-day compressive strength test on concrete masonry walls in accordance with ASTM E447, Method B.

3.12 STRUCTURAL STEEL

- A. Inspection Services:
1. General:
 - a. Review submittals from fabricator.
 - b. Review all shop and field welder's qualifications.
 2. Structural Steel, Steel Joists and Mechanical Piping:
 - a. Shop inspect each member for defects such as cracks, excessive camber, deformation, and specified surface preparation prior to shop priming or galvanizing.
 - b. Inspect shop priming for coverage and measure of mil thickness.
 - c. Perform visual inspection of all welds; measure 15 percent of welds.
 - d. Inspect size and placement of anchor bolts in concrete and masonry.
 - e. Verify that erector surveys plumbness of each column.
 - f. Verify that erector inspects alignment of beams, shelf angles, lintels, joists, joist girders, and other similar supporting members.
 - g. Perform visual inspection of bolts to determine that the method(s) used are in conformance with the Contract Documents.
 3. Metal Decks:
 - a. Field inspect material for type, gauge, finish and other requirements of the Contract Documents.
 - b. Field inspect installation methods including welding, alignment, joints, laps, and flatness, and all other requirements of the Contract Documents.

4. Steel Stud Shear Connectors:
 - a. Field inspect installation methods and welds.
 - b. Verify number of studs, stud placement and length for conformance with the Contract Documents.

- B. Testing Services:
 1. References (As applicable for tests required):
 - a. American Institute of Steel Construction (AISC)
 - 1) Specifications for Structural Joints Using ASTM A325 or A490 Bolts
 - b. ASTM International (ASTM)
 - 1) A6, General Requirements for Rolled Steel Plates, Shapes, Sheet Piling, and Bars for Structural Use
 - 2) A325, Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
 - 3) A490, Standard Specification for Heat-Treated Steel Structural Bolts, 150 ksi Minimum Tensile Strength
 - b. American Welding Society (AWS)
 - 1) D1.1, Structural Welding Code, Steel
 2. Structural Steel:
 - a. Perform all tests required by Structural Welding Code and authorities having jurisdiction.
 - b. Ultrasonically test all edges of material greater than 1-1/2 inch thick that is to be welded for evidence of laminations, inclusions, or other discontinuities. The extent to which such defects will be permitted, and the extent of repair permitted shall be in accordance with ASTM A6.
 - c. The root layer of all multiple pass welds and the backside of groove welds made from both sides, after back gouging or chipping, shall be tested by magnetic particle or dye penetration if magnetic particle is not feasible.
 - d. Fillet welds for beam and girder shear connections (15 percent at random) shall be tested by magnetic particle for final pass only.
 - e. Fillet welds for plate girder flange/web connections shall be tested by magnetic particle for final pass only.
 - f. Ultrasonically test 100 percent of full penetration welds.
 - g. Ultrasonically test 100 percent of partial penetration column splice welds.
 - h. Test 100 percent of continuity plate fillet welds by magnetic particle for final pass.
 - i. Perform all equipment calibrations and production tests of high strength bolt connections as required by AISC Specifications for Structural Joints Using ASTM A325 or A490 Bolts.
 - j. Randomly sample bolts, nuts, and washers from the Project Site at a rate sufficiently to test and verify compliance with ASTM Standards.
 - k. When bolts are tightened by "turn-of-the-nut" method, check by calibrated torque wrench 25 percent of bolts in each shear connection, but not less than two (2) bolts per connection.
 - l. In addition, provide at least one (1) test per 50 linear inches of weld by each welder, except that 100 percent of full penetration welds shall be tested using approved radiographic, magnetic particle, or ultrasonic method. Tolerance for welds shall be in accordance with the requirements of AWS D1.1 and the Contract Drawings.
 - m. Perform tension tests on steel in accordance with ASTM A6, if required.
 - n. Perform load tests on structural members in place, if required.
 3. Steel Stud Testing:
 - a. Test not less than ten (10) percent of studs on any beam, plus all studs indicating imperfections. Studs will be considered imperfect if, after welding, visual inspection reveals:
 - 1) Studs lacking full 360-degree weld.
 - 2) Studs which have been repaired by welding.

- b. Studs shall be tested by striking with a hammer and bending to approximately 15 degrees off vertical. Bend studs lacking full 360 degrees weld in a direction opposite to the side lacking the weld. Replace studs that crack after this test either in the weld or the shank. Studs meeting this test will be considered acceptable and left in place.

3.13 SPRAYED-ON FIREPROOFING

- A. Inspection Services:
 1. Inspection of sprayed-on fireproofing to ascertain compliance with Contract Documents.
- B. Testing Services:
 1. References (As applicable for tests required):
 - a. ASTM International (ASTM)
 - 1) E605, Thickness and Density of Sprayed Fire-Resistive Material (SFRM) Applied to Structural Members
 - 2) E736, Cohesion/Adhesion of Sprayed Fire-Resistive Materials Applied to Structural Members
 2. Perform tests on sprayed-on fireproofing for thickness and density in accordance with ASTM E605.
 3. Perform tests on sprayed-on fireproofing for cohesion and adhesion in accordance with ASTM E736.

3.14 LIGHTWEIGHT INSULATING CONCRETE FILL

- A. Inspection and Observation Services:
 1. Inspection of roof deck prior to start of work.
 2. Inspection during installation of insulation and lightweight insulating concrete fill work to ascertain compliance with Contract Documents.
 3. Observation of base ply fastener pull tests performed by Testing Lab to ascertain minimum withdrawal resistance of 40 pounds per square foot per fastener, based on ANSI/SPRI Protocol. Architect and Roofing Inspector to witness fastener pull tests.
- B. Testing Services:
 1. References (As applicable for tests required):
 - a. ASTM International (ASTM)
 - 1) C177, Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties By Means of the Guarded-Hot-Plate Apparatus
 - 2) C495, Test Method for Compressive Strength of Lightweight Insulating Concrete
 - 3) C578, Specification for Rigid, Cellular Polystyrene Thermal Insulation
 2. Test EPS insulation board for thermal insulation value in accordance with ASTM C177.
 3. Test lightweight insulating concrete fill in accordance with ASTM C495 for:
 - a. Mix design compressive strength.
 - b. Mix design wet and dry density range.
 - c. Number of Tests:
 - 1) One (1) per 5,000 square feet
 - 2) Not less than one (1) for each day's work
 4. Test EPS insulation board for density in accordance with ASTM C578.

3.15 ROOFING SYSTEM

- A. Inspection and Observation Services:
 1. Attend pre-construction meeting prior to Contractor starting work.

2. Attend pre-installation meetings for decking, lightweight concrete, roofing, and sheet metal installations.
3. Review field mockups of sheet metal and other components as applicable.
4. Inspect on-site condition of stored roofing materials
5. Provide full-time roofing inspector during the following stages of construction:
 - Final stages of metal deck attachment
 - Lightweight concrete roof deck application
 - Modified bitumen roofing and metal roofing application
6. Provide spot inspections for sheet metal work and thru-wall flashing. Thru-wall flashing shall be left open by the Contractor until inspected, and sheet metal shall not be covered until inspected.
7. Witness water tests and pull tests completed by others.
8. Observe roof test cuts, and patching of cuts, performed by Contractor to ascertain that they are properly made.
9. Perform dissection and analysis on cuts provided by Contractor to confirm number of plies, bonding of plies, weight of bitumen and softening temperature to ascertain compliance with specifications.
10. Provide a written daily report in standardized format to Owner within 72 hours of inspection. The report shall describe all roofing-related activities as well as recommendations made to Contractor by the Inspector. The report shall also include a running list of items from previous reports that have not yet been addressed by Contractor. The reports shall also include an itemization of items that should be backcharged to the Contractor. Submit report to Contractor, Architect, and Owner.
11. Provide and maintain a sign-in sheet in the construction trailer. **Inspector shall sign in and out for every inspection, or Owner will not pay for that inspection.**
12. Attend the punch list walk and provide a written punch list of all roofing components to Architect and Owner.
13. Conduct a final inspection of all roofing components and provide Owner with a letter confirming that all punch list items are complete.
14. Review Siplast Warranty and provide a letter to the Owner confirming that it is correct and complete.

3.16 GLAZED SYSTEMS, TRANSLUCENT WALL PANEL SYSTEMS AND SKYLIGHTS

- A. Testing Services:
 1. Perform air and water infiltration testing on initial installation of each exterior glazed system, translucent wall panel system and skylight to ascertain compliance with specifications.

PART 4 – GENERAL – PROJECT CONSULTANT OBSERVATIONS

4.1 DESCRIPTION

- A. The Contractor shall include in his Proposal the coordination and scheduling of Observations to be performed by the Owner and Architect's project consultants, as they may apply to this work.
- B. All project consultant observation services shall be performed by designees of the relative consultant; upon which the Contractor may rely as to the capability and thoroughness of the observation being performed. Upon request by the Contractor, the names of inspectors performing specific observations shall be furnished by the Architect.
- C. The Owner shall pay for the observation services of the project consultants in accordance with the Owner / Architect Agreement and the requirements of the Contract Documents. Excessive observations and re-observations resulting from the Contractor's actions as described in paragraph 4.4 below, shall be paid for by the Contractor directly to the affected Consultant.

- D. The Contractor shall cooperate with the Owner's project consultants in all matters pertaining to required observations of the work as described in the Contract Documents. The Owner retains the option to add to or delete any or all observations specified herein; and thereby accept the relative work without observation.

4.2 RELATED REQUIREMENTS

- A. Conditions of the Contract, AIA Document A201 as amended, and Supplementary Conditions to the General Conditions for the Construction Contract, Specification section CA.
- B. Respective Sections of Specifications describing the required consultant observations.

4.3 AUTHORITIES AND DUTIES OF THE PROJECT CONSULTANT INSPECTORS

- A. The project consultant inspectors are not authorized to revoke, alter, relax, increase, or release the Contractor from any requirement of the Contract Documents without written notice furnished to the Contractor by the Architect. When it appears that the material, assembly or work performed by the Contractor fails to fulfill Contract requirements, the project consultant inspector shall promptly notify the General Contractor, Architect and Owner.
- B. The project consultant inspector(s) shall distribute copies of the observation reports within two (2) working days. Standard distribution shall include copies of all reports to the Owner, Architect, and General Contractor.

4.4 PROJECT CONSULTANT OBSERVATION GUIDELINES AND PROCEDURES

- A. Project Consultants shall make all observations required in the Contract Documents and requested by the Architect, Contractor and/or Owner.
- B. For each material, assembly or phase observation required in the Contract Documents, and upon request by the Contractor, the project consultant(s) shall perform the following observations as required in the Owner – Architect Agreement:
 - 1. Initial observation to determine compliance with the Contract Documents.
 - 2. Observation to determine deficiencies where the initial observation results do not show 100% compliance with the Contract Documents. At the consultant's discretion, this observation may be performed concurrent with the initial observation.

The above series of observations shall be at the expense of the Owner in accordance with the Owner/Architect Agreement. If re-observation is required to determine 100% compliance is required, it shall be at Contractor's expense.

- C. In the event the observation series described above does not result in 100% approval of the material, assembly or phase being inspected, all subsequent re-observations required to achieve 100% approval shall be at the sole expense of the Contractor to be paid to the project consultant (via Owner backcharge to the Contractor) based on the consultant's standard hourly rates for time expended, including travel to and from the site.
- D. Recognizing the size and complexity of work included in a project may be sufficiently large enough to require the project to be divided into scope areas, each such area shall be considered separate and stand-alone with respect to paragraph 4.4.B above. Requests by the Contractor for project consultant observations of partial scope areas shall be considered observations of the entire scope area with respect to paragraph 4.4.B above; and subsequent observations of the remaining portions of the same scope area shall be paid for by the Contractor (via Owner backcharge to the Contractor). Owner shall invoice the Contractor on a monthly basis, and payment shall be due upon the Contractor's receipt of the invoice.

- E. The Contractor shall bear the responsibility of requesting and scheduling all project consultant observations required by the Contract Documents. The Contractor shall give the project consultant a minimum of forty-eight (48) hours' notice prior to the requested observation. No extension of Contract Time shall be granted for untimely observations due to the Contractor's failure of proper observation request notification.
- F. Observations voluntarily made by project consultants at their discretion, not specifically requested by the Contractor, shall not count as one of the observations described in paragraph B above, nor shall the Contractor be liable for any related expenses.

4.5 PROJECT CONSULTANT OBSERVATIONS

- A. Earthwork
- B. Site Utilities prior to cover-up
- C. Concrete Reinforcing
- D. Cast-in-place concrete
- E. Structural steel
- F. All Building Envelope assemblies
- G. Mechanical rough-in prior to cover-up
- H. Plumbing rough-in prior to cover-up
- I. Electrical rough-in prior to cover-up
- J. Above ceiling prior to cover-up
- K. Start-up demonstrations of building systems and components
- L. Punch lists (treated separately for each architect and consultant). Refer to Specification Section CA, section 9.8
- M. Observation / review of O&M Manuals and other close-out documents
- N. Observation / review of Record Drawings

4.6 PROJECT CONSULTANT HOURLY RATES

- A. Refer to the A201 General Conditions of the Contract for Construction, as Amended Article 8 for applicable hourly rates.

PART 5 – GENERAL – GOVERNMENTAL INSPECTIONS

5.1 DESCRIPTION

- A. The Contractor shall include in his Proposal the application, coordination, scheduling and cost of all on-site inspections to be performed by governmental authorities having jurisdiction which are required for approval of the Work and occupancy of the building; including, but not limited to all City departments, all County departments, Flood Control Districts, Municipal Utility Districts, utility provider, Health Departments and Fire Marshal Offices.

- B. The Contractor shall make all corrective measures in accordance with instructions received from the governing authority inspector having jurisdiction, as required to receive 100% approval for the work being inspected.
- C. The Contractor shall bear all costs for initial inspections, re-inspections and any other expenses related to on-site inspections made by governing authority.
- D. No allowance shall be made for additional Contract Time, nor an increase in the Contract Sum for any unanticipated expenses or delays resulting from failed governmental inspection or resulting re-inspections required to obtain approval(s).

5.2 EXCLUSION

- A. The Contractor shall not be responsible for making application, coordination, inspections and receiving approval of the Work by the Texas Department of Licensing and Regulation relative to ADA and Texas Accessibility Standards.

END OF SECTION

SECTION 01 50 00

TEMPORARY FACILITIES

CONDITIONS OF THE CONTRACT and DIVISION 1, as indexed, apply to this Section.

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Refer to Instructions to Proposers for substitutions.
- B. Temporary facilities shall only be for the duration of construction, unless noted otherwise, and all temporary facilities shall be completely removed at the completion of the project. Any areas disturbed by the placement of temporary facilities shall be repaired/replaced to a finished condition consistent with the surrounding finished area.

1.2 UTILITIES

- A. The Contractor shall supply temporary job power, drainage outfall, sanitary sewer, and water hook-ups for site. The Contractor shall provide all wiring, lamps, distribution of power and similar equipment as required for construction, inspection, and testing of each project.
- B. The Contractor is responsible for overloading or excess use, or any damage resulting from overloading or excess use, or any damage resulting from his use of utilities.
- C. The General Contractor shall provide temporary heat to prevent freezing and maintain proper temperatures to avoid damage to materials in the building and allow work to continue in such weather conditions. The General Contractor shall provide and maintain such dependable source of supply, such as heat, as may be necessary until the building is accepted.
- D. The Contractor will be required to provide temporary water and electrical connections for field sprinkler systems after Substantial Completion of the fields. These connections must be maintained through the duration of the Contract, or until permanent connections are made.
- E. Any utility usage at existing buildings in excess of 110% of historical usage for the previous 12-month period shall be paid by the Contractor.

1.3 FIELD OFFICE

- A. The Contractor will be required to furnish a job trailer installed at a suitable location (on site at one campus), for use by the Contractor, Architect, and Owner.
- B. Provide and maintain a weather-tight building with operable and lockable door and windows, to serve as a job office available to the Contractor, subcontractors, Owner, and the Architect. Provide lights, electricity, air conditioning and heat, as required. Remove office from premises when one can be set up inside the building. Provide job site telephone, internet, and other miscellaneous items as outlined below.
 - 1. Provide a separate lockable room (120 sq. ft.) in Contractor's job trailer to serve as an office for the Architect and Owner's representative or provide in a separate building in close proximity to Contractor's office.
 - 2. Contractor's office shall be of a size, and shall be furnished, so that it may be used for small progress meetings (seating for approximately 8 persons at table).
 - 3. Provide adequate artificial lighting, heating and cooling to provide comfortable conditions for occupants.
 - 4. Provide direct line telephone service for both voice communication and internet connection.
 - 5. Furnishings Required:
 - a. Contractor's Office: Racks and files for Contract Documents and for Record Documents; conference table and chairs; and desks and chairs as required by Contractor.

- b. Architect's Office: One lay-out drafting table 36" x 72" x 36" high; one standard desk with three drawers; chair and drafting stool. Provide one drawing rack for 30" x 42" drawings.
- 6. Provide high speed data access with internet access and wireless access point/router.

1.4 SANITARY FACILITIES

- A. Furnish temporary sanitary facilities and maintain in compliance with regulations of State Department of Health and other authorities having jurisdiction (minimum of one water closet and hand sink).

1.5 STORAGE FACILITIES

- A. Provide and maintain adequate weathertight lockable storage facilities, raised above the ground, with sides and top enclosed.
- B. Replace materials improperly stored and damaged by weathered conditions.
- C. Remove storage facilities when materials are stored within the structure in a weathertight condition.
- D. Allow for temporary freeze protection as needed.
- E. Address any storage needs for owner equipment, furniture, etc.

1.6 SIGNS

- A. Within three weeks after receipt of Notice to Proceed, provide one project identification sign and install in a location designated by the Owner at each campus.
- B. Fabricate the sign with sturdy wood framing and 3/4-inch-thick exterior grade plywood, with aluminum overlay and applied digitally printed vinyl sign, a minimum area of 64 cumulative square feet (8' x 8'). No other signs, except as allowed herein, shall be allowed to be displayed on the site. Contractor shall submit a scaled shop drawing of the sign, including all lettering, to the Owner for approval prior to installation.
- C. Project sign shall incorporate design layout as provided by Architect, and shall include:
 - 1. The official title of the Project as listed on Contract Documents.
 - 2. The name of the Owner as listed on Contract Documents.
 - 3. The names and titles of School Board Members and School Administrators.
 - 4. The names and titles of Architect.
 - 5. Identification number of the Contractor.
- D. Erect signs on 4" (102 mm) x 4" (102 mm) supports set firmly into the ground and well braced. The bottom of the sign is to be a minimum of 4' above grade, unless otherwise instructed by the Architect.
- E. Other signs required at the site:
 - 1. Warning, directional, and identification signs as required to indicate construction office location, and to facilitate campus operations that are impacted by construction.
- F. Contractor shall provide necessary signage to accommodate all Owner needs necessitated by the Work including temporary walking/driving routes, deliveries, etc.
- G. Allow no other signs to be displayed at the project site, unless authorized by the Owner.
- H. Secure and pay for all sign permits as required by local authorities.
- I. The sign shall remain the property of the Owner, and upon final completion, the Contractor shall remove the sign and deliver it to a location designated by the Owner or dispose of sign if directed by Owner.

1.7 BARRIERS

- A. Provide temporary barricades on all portions of the site as required to secure the construction area and affected areas of building and site.
- B. Provide approved barriers around trees and plants designated to remain. Protect against vehicular traffic, stored materials, dumping, chemically injurious materials, water puddling and continuous running water.
- C. Provide temporary partitions as needed to separate work areas from building occupants.

1.8 SECURITY

- A. Determine if and when watchmen are necessary for protection to the work and provide such services when necessary. Neither the provision of watchmen nor the failure to provide watchmen shall relieve the Contractor of responsibility in event of injury to persons or damage to property.

1.9 CLEANING

- A. **Trash Removal:** Clear the building and site daily of trash. When rapid accumulation occurs, make more frequent removals. Remove highly combustible trash such as paper and cardboard daily. Dumpsters will not be allowed to overflow and should be emptied on a regular basis. Subcontractors shall provide their own dumpsters for disposal of their debris.
- B. **Daily cleanup (renovation and new construction projects):** Daily cleanup is required both within construction area, and also for any areas on site that are used by Owner (sidewalks, drives, roads, corridors, etc.).
- C. **Disposition of Debris:** Remove debris from the site and make legal disposition. Locations for disposal shall be of the Contractor's choice within the above restriction. Neither debris nor material may be buried or burned at the site. Take necessary precautions to prevent accidental burning of materials by avoiding large accumulations of combustible materials.
- D. Refer to Section 01 71 50 for Preventive Housekeeping.

2.0 TEMPORARY FIRST AID FACILITIES

- A. Provide first aid equipment and supplies, with qualified personnel continuously available to render first aid at the site.
- B. Provide a sign, posted at the telephone, listing the telephone numbers for emergency medical services: physicians, ambulance services and hospitals.
- C. Provide and maintain one Automated External Defibrillator (AED) unit throughout duration of the project.

2.1 TEMPORARY FIRE PROTECTION

- A. Provide a fire protection and prevention program for employees and personnel at the site; and provide and maintain fire extinguishing equipment ready for instant use at all areas of the project, and at specific areas of critical fire hazard.
- B. **Equipment:**
 - 1. Hand extinguishers of the types and sizes recommended by the National Board of Fire Underwriters to control fires from particular hazards.
 - 2. Barrels of water with buckets designated for fire control purposes.
 - 3. Water hoses connected to an adequate water pressure and supply system.
 - 4. Construction period use of permanent fire protection system.

- C. Enforce Fire-safety Discipline:
 - 1. Store volatile materials in an isolated, protected location.
 - 2. Avoid accumulations of flammable debris and waste in or about the Project.
 - 3. Prohibit smoking on CFISD property and in the vicinity of hazardous conditions.
 - 4. Closely supervise welding and torch-cutting operations in the vicinity of combustible materials and volatile conditions, including roofing torching operations.
 - 5. Supervise locations and operations of portable heating units and fuel.
- D. Maintain fire extinguishing equipment in working condition, with current inspection certificate attached to each extinguisher.
- E. Contractor shall coordinate and comply with all requirements of Owner's personnel, as well as those of governing authorities.

2.2 CONSTRUCTION AIDS

- A. Provide construction aids and equipment required to assure safety for personnel and to facilitate the execution of the work; scaffolds, staging, ladders, stairs, ramps, runways, platforms, railings, hoists, cranes, chutes and other equipment.
- B. When permanent stair framing is in place, provide temporary treads, platforms and railings, for use by construction personnel.
- C. Maintain all equipment in a first-class, safe condition.

2.3 ACCESS ROADS AND PARKING AREAS

- A. Submit to CFISD for review and upon written approval, provide adequate temporary roads and walks to achieve all-weather car access into the site from public thoroughfares, and within and adjacent to the site, as necessary to provide interrupted access to field offices, work and storage areas. All temporary access roads and walks shall be removed upon completion of permanent facilities, or completion of construction.
- B. Provide adequate parking space for personnel and employees at the site, located to avoid interference with traffic adjacent school facilities and functions, work or storage areas, or with materials-handling equipment.
- C. Grade and provide drainage facilities to assure runoff of rainwater and to avoid blockage of flow from adjacent areas.

END OF SECTION

SECTION 01 55 26 - TRAFFIC CONTROL AND REGULATION

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Requirements for signs, signals, control devices, traffic barriers, flares, lights and traffic signals; construction parking control, designated haul routes, and bridging of trenches and excavations.
- B. Qualifications and requirements for use of flagmen.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Price Contracts.
 - 1. Traffic control and regulation. Payment for traffic control and regulation is on a lump sum basis. Include preparation and submittal of traffic control plan if different than shown on Drawings, and provision of traffic control devices, equipment, and personnel necessary to protect the Work and public. Payment will be based on Contractor's Schedule of Values for traffic control and regulation.
 - 2. Flagmen. Payment for flagmen is on a lump sum basis. Partial payments will be based on Contractor's Schedule of Values for flagmen.
 - 3.
 - 4. New Portable Concrete Low Profile Traffic Barrier Provided. Payment is on a unit price basis for each linear foot of low-profile traffic barrier provided, installed with hardware assemblies, and connected together in accordance with the approved traffic control plan.
 - 5. Portable Concrete Low Profile Traffic Barrier picked up from Stockpile. Payment is on a unit price basis for each linear foot of low-profile traffic barrier picked up from designated stockpile, moved onto the project, set at location, and connected together.
 - 6. Portable Concrete Low Profile Traffic Barrier Installed. Payment is on a unit price basis for each linear foot of low-profile traffic barrier delivered to the project location, installed with hardware assemblies, and connected together in accordance with the approved traffic control plan.
 - 7. Portable Concrete Low Profile Traffic Barrier Moved and Reset. Payment is on a unit price basis for each linear foot of low-profile traffic barrier disassembled, moved on the project, reset at the new locations, and connected together. Include cost to repair roadway in the unit price.
 - 8. Portable Concrete Low Profile Traffic Barrier Removed. Payment is on a unit price basis for each linear foot of low-profile traffic barrier removed from the project, including hardware assemblies, and stockpiling at location listed in Division 1. Include cost to repair roadway in the unit price.
 - 9. Refer to Division 1 for unit price procedures.
- B. Stipulated Price Contracts. Include payment for work under this section in the total Stipulated Price.

1.3 REFERENCES

- A. Texas Manual on Uniform Traffic Control Devices (TMUTCD)
- B. Article 4413 (29bb), commonly referred to as Private Investigators and Private Security Agencies Act, and Article 2.12, Texas Code of Criminal Procedure.

1.4 SUBMITTALS

- A. Conform to requirements of Division 1.
- B. Traffic control plan:
 - 1. If using traffic control plan contained in the Contract without modification, submit a letter confirming use of the plan.
 - 2. If using a different traffic control plan, submit the plan for approval. The plan must conform to TMUTCD requirements and be sealed by a Registered Texas Professional Engineer.
- C. Submit copies of approved lane closure permits issued by all governmental authorities.
- D. Submit Schedules of Values for traffic control plan and flagmen within 30 days following Notice to Proceed.
- E. Submit records verifying qualifications of Uniformed Peace Officers and Certified Flagmen proposed for use on the Work.

1.5 FLAGMEN

- A. Use Uniformed Peace Officers and Certified Flagmen to control movement of vehicular and pedestrian traffic when construction operations encroach on public traffic lanes.
- B. Uniformed Peace Officer: Individual employed full-time as a peace officer who receives separate compensation as a privately employed flagman. Private employment may be an employee-employer relationship or on an individual basis. Flagman may not be in the employ of another peace officer nor be a reserve peace officer.
 - 1. Uniformed Peace Officers may be:
 - a. Sheriffs and their deputies;
 - b. Constables and deputy constables;
 - c. Marshals or police officers of an incorporated city, town, or village; or
 - d. As otherwise provided by Article 2.12, Code of Criminal Procedure.
 - 2. The Uniformed Peace Officer must be a full-time peace officer, must work a minimum average of 32 paid hours per week, and must be paid a rate not less than the prevailing minimum hourly wage rate set by the federal Wage and Hour Act. The individual must be entitled to vacation, holidays, and insurance and retirement benefits.
- C. Certified Flagman: Individual who receives compensation as a flagman and meets the following qualifications:
 - 1. Formally trained and certified in traffic control procedures by the City's E. B. Cape Center.
 - 2. Speaks English. Ability to speak Spanish is desirable but not required.
 - 3. Paid for flagman duty at an hourly rate not less than the wage rate set for Rough Carpenter under the City of Houston's Wage Scale for Engineering Construction.
- D. Certified Flagmen must wear a distinctive uniform, bright-colored vest, and be equipped with appropriate flagging and communication devices while at the Work site. They must also have in their possession while on duty, a proof of training identification card issued by the appropriate training institute.

PART 2 PRODUCTS

2.1 SIGNS, SIGNALS, AND DEVICES

- A. Comply with TMUTCD requirements.
- B. Traffic cones and drums, flares, and lights: Conform to local jurisdictions' requirements.

2.2 PORTABLE LOW PROFILE CONCRETE BARRIERS

- A. The low-profile concrete barrier is a patented design. Information concerning this barrier may be obtained from Texas Transportation Institute, Texas A&M University System, College Station, Texas 77843-3135, (409) 845-1712.

PART 3 EXECUTION

3.1 PUBLIC ROADS

- A. Submit requests forms for lane closure and sidewalk closure to the appropriate governmental authority at least three working days prior to need for blocking vehicular lanes or sidewalks. Do not block lanes or sidewalks without approved permits.
- B. Follow laws and regulations of governing jurisdictions when using public roads. Pay for and obtain permits from jurisdiction before impeding traffic or closing lanes. Coordinate activities with Owner's Representative.
- C. Give Owner's Representative one-week notice before implementing approved traffic control phases. Inform local businesses of impending traffic control activities.
- D. Notify police department, fire department, METRO, and local schools, churches, and businesses in writing a minimum of five business days prior to beginning work.
- E. Maintain 10-foot-wide all-weather lanes adjacent to the Work for emergency vehicle use. Keep all-weather lanes free of construction equipment and debris.
- F. Do not obstruct normal flow of traffic from 7:00 a.m. to 9:00 a.m. and 4:00 p.m. to 6:00 p.m. on designated major arterials or as directed by Owner's Representative.
- G. Maintain local driveway access to residential and commercial properties adjacent to work areas at all times. Use all-weather materials approved by Owner's Representative to maintain temporary driveway access to commercial and residential driveways.
- H. Keep streets entering and leaving job site free of excavated material, debris, and foreign material resulting from construction operations in compliance with applicable ordinances.
- I. Remove existing signage and striping that conflict with construction activities or that may cause driver confusion.
- J. Provide safe access for pedestrians along major cross streets.
- K. Alternate closures of cross streets so that two adjacent cross streets are not closed simultaneously.

- L. Do not close more than two consecutive esplanade openings at a time without prior approval from Owner's Representative.

3.2 CONSTRUCTION PARKING CONTROL

- A. Control vehicular parking to prevent interference with public traffic and parking, access by emergency vehicles, and the Owner's operations.
- B. Monitor parking of construction personnel's vehicles in existing facilities. Maintain vehicular access to and through parking areas.
- C. Prevent parking on or adjacent to access roads or in non-designated areas.

3.3 FLARES AND LIGHTS

- A. Provide flares and lights during hours of low visibility to delineate traffic lanes and to guide traffic.

3.4 HAUL ROUTES

- A. Utilize haul routes designated by authorities or shown on Drawings for construction traffic.
- B. Confine construction traffic to designated haul routes.
- C. Provide traffic control at critical areas of haul routes to regulate traffic and minimize interference with public traffic.

3.5 TRAFFIC SIGNS AND SIGNALS

- A. Construct necessary traffic control devices for temporary signals required to complete the Work including loop detectors, traffic signal conduits, traffic signal wiring and crosswalk signals. Notify the governmental agency having jurisdiction a minimum of 60 days in advance of need for control boxes and switchgear. The Contractor will pay for all necessary service, programming, or adjustments, to signal boxes and switchgear if required during construction.
- B. Install and operate traffic control signals to direct and maintain orderly traffic flow in areas under Contractor's control affected by Contractor's operations. Post notices, signs, and traffic controls before moving into next phase of traffic control.
- C. Relocate traffic signs and signals as the Work progresses to maintain effective traffic control.
- D. Unless otherwise approved by Owner's Representative, provide driveway signs with name of business that can be accessed from each crossover. Use two signs for each crossover.
- E. Replace existing traffic control devices in Project area.
- F. Owner's Representative may direct Contractor to make minor adjustments to traffic control signage to eliminate driver confusion and maintain orderly traffic flow during construction at no additional cost to the Owner.

3.6 BRIDGING TRENCHES AND EXCAVATIONS

- A. When necessary, construct bridges over trenches and excavation to permit an unobstructed flow of traffic across construction areas and major drives. Use steel plates of sufficient thickness to support H-20 loading and install to operate with minimum noise.

- B. Shore trench or excavation to support bridge and traffic.
- C. Secure bridging against displacement with adjustable cleats, angles, bolts, or other devices when:
 - 1. Bridging is placed over existing bus routes,
 - 2. More than five percent of daily traffic is comprised of commercial or truck traffic,
 - 3. More than two separate plates are used for bridging, and
 - 4. When bridge is to be used for more than five consecutive days.
- D. Extend steel plates used for bridging a minimum of 1 foot beyond edges of trench or excavation. Use temporary paving materials such as premix to feather edges of plates to minimize wheel impact on secured bridging.

3.7 REMOVAL

- A. Remove equipment and devices when no longer required.
- B. Repair damage caused by installation.
- C. Remove post settings to a depth of 2 feet.

3.8 TRAFFIC CONTROL, REGULATION AND DIRECTION

- A. Use Flagmen to control, regulate and direct an even flow and movement of vehicular and pedestrian traffic, for periods of time as may be required to provide for public safety and convenience, where:
 - 1. Multi-lane vehicular traffic must be diverted into single lane vehicular traffic,
 - 2. Vehicular traffic must change lanes abruptly,
 - 3. Construction equipment must enter or cross vehicular traffic lanes and walks,
 - 4. Construction equipment may intermittently encroach on vehicular traffic lanes and unprotected walks and crosswalks,
 - 5. Traffic regulation is needed due to rerouting of vehicular traffic around the Work site, and
 - 6. Where construction activities might affect public safety and convenience.
- B. Use of Flagmen to assist in the regulation of traffic flow and movement does not relieve Contractor of responsibility to take other means necessary to protect the Work and public.

3.9 INSTALLATION STANDARDS

- A. Place temporary pavement for single lane closures, in accordance with TMUTCD.
- B. Reinstall temporary and permanent pavement markings as approved by Owner's Representative. When weather conditions do not allow application according to manufacturer's requirements, alternate markings may be considered. Submit proposed alternate to Owner's Representative for approval prior to installation. No additional payment will be made for use of alternate markings.

3.10 MAINTENANCE OF EQUIPMENT AND MATERIAL

- A. Submit name, address and telephone number of individual designated to be responsible for maintenance of traffic handling at construction site to Owner's Representative. Individual must be accessible at all times to immediately correct deficiencies in equipment and materials used to handle traffic including missing, damaged, or obscured signs, drums, barricades, or pavement markings.

- B. Inspect signs, barricades, drums, lamps, and temporary pavement markings daily to verify that they are visible, in good working order, and conform with traffic handling plans as approved by Owner's Representative. Immediately repair, clean, relocate, realign, or replace equipment or materials that are not in compliance.
- C. Keep equipment and materials, signs, and pavement markings, clean and free of dust, dirt, grime, oil, mud, or debris.
- D. Obtain approval of Owner's Representative to reuse damaged or vandalized signs, drums, and barricades.

END OF SECTION

SECTION 01 57 23 - TEMPORARY STORM WATER POLLUTION CONTROL

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Implementation of Storm Water Pollution Prevention Plans (SWP3) described in Division 1.
- B. Installation and maintenance of storm-water pollution prevention structures: diversion dikes, interceptor dikes, diversion swales, interceptor swales, down spout extenders, pipe slope drains, paved flumes and level spreaders. Structures are used during construction and prior to final development of the site.
- C. Filter Fabric Fences:
 - 1. Type 1: Temporary filter fabric fences for erosion and sediment control in non-channelized flow areas.
 - 2. Type 2: Temporary reinforced filter fabric fences for erosion and sediment control in channelized flow areas.
- D. Straw Bale Fence.

1.2 MEASUREMENT AND PAYMENT

A. UNIT PRICES

- 1. Payment for filter fabric fence is on a linear foot basis measured between limits of beginning and ending of stakes.
- 2. Payment for reinforced filter fabric fence is on a linear foot basis measured between limits of beginning and ending of stakes.
- 3. Payment for drop inlet baskets is on a unit price basis for each drop inlet basket.
- 4. Payment for storm inlet sediment traps is on a unit price basis for each storm inlet sediment trap.
- 5. Payment for storm-water-pollution-prevention structures is on a lump sum basis for the project. Earthen structures with outlet and piping includes diversion dikes, interceptor dikes, diversion swales, interceptor swales, and excavated earth-outlet sediment trap, embankment earth-outlet sediment trap, down spout extenders, pipe slope drains, paved flumes, stone outlet sediment trap, and level spreaders.
- 6. Payment for straw bale barrier, if included in Bid Form, is on a linear foot of accepted bale barriers, if not include in cost of storm-water-pollution-prevention structures.
- 7. Payment for brush berm, if included in Bid Form, is on a linear foot of accepted brush berm, if not include in cost of storm water-pollution-prevention structures.
- 8. Payment for sandbag barrier, if included in Bid Form, is on a linear foot basis measured between limits of beginning and ending of sandbags, if not include in cost of storm-water-pollution prevention structures.
- 9. Payment for sediment basin with pipe outlet or stone outlet, if included in Document 00410 - Bid Form, is on a square yard basis, if not include in cost of storm-water-pollution-prevention structures.
- 10. Payment for inlet protection barriers, if included in Document 00410 - Bid Form, is on a linear foot basis measured along outside face of inlet protection barrier, if not include in cost of storm-water-pollution prevention structures.
- 11. Refer to Division 1 for unit price procedures.

- B. Stipulated Price (Lump Sum) Contract. If Contract is Stipulated Price Contract, payment for Work in this Section is included in total Stipulated Price.

1.3 REFERENCE STANDARDS

A. ASTM

1. A 36 - Standard Specification for Carbon Structural Steel.
2. D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort [12,400 ft-lbf/ft³ (600 kN-m/m³)].
3. D3786 - Standard Test Method for Hydraulic Bursting Strength for Knitted Goods and Nonwoven Fabrics.
4. D 4355 - Standard Test Method for Deterioration of Geotextiles from Exposure to Ultraviolet Light and Water (Xenon-Arc Type Apparatus).
5. D 4491 - Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
6. D 4632 - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
7. D 4833 - Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products.
8. D 6382 - Standard Practice for Dynamic Mechanical Analysis and Thermogravimetry of Roofing and Waterproofing Membrane Material.

- B. Storm Water Management Handbook for Construction Activities prepared by City of Houston, Harris County and Harris County Flood Control District.

1.4 SYSTEM DESCRIPTIONS

- A. Filter Fabric Fence Type 1 and Type 2: Install to allow surface or channel runoff percolation through fabric in sheet-flow manner and to retain and accumulate sediment. Maintain Filter Fabric Fences to remain in proper position and configuration at all times.
- B. Straw Bale Fence: Install to allow surface runoff percolation through straw in sheet-flow manner and to retain and accumulate sediment. Maintain Straw Bale Fence to remain in proper position and configuration at all times.
- C. Interceptor Dikes and Swales: Construct to direct surface or channel runoff around the project area or runoff from project area into sediment traps.
- D. Drop Inlet Baskets: Install to allow runoff percolation through the basket and to retain and accumulate sediment. Clean accumulation of sediment to prevent clogging and backups.
- E. Sediment traps: Construct to pool surface runoff from construction area to allow sediment to settle onto the bottom of trap.

1.5 SUBMITTALS

- A. Conform to requirements of Division 1.
- B. Submit manufacturer's literature for product specifications and installation instructions.
- C. Submit manufacturer's catalog sheets and other product data on geotextile or filter fabrics, outlet pipe, perforated riser and connectors.
- D. Submit proposed methods, equipment, materials, and sequence of operations for storm-water pollution prevention structures.
- E. Submit shop drawings for Drop Inlet Baskets.

PART 2 PRODUCTS

2.1 CONCRETE

- A. Concrete: Class B in accordance with Division 1 or as shown on the Drawings.

2.2 AGREGATE MATERIALS

- A. Use poorly graded cobbles with diameter greater than 3 inches and less than 5 inches.
- B. Provide gravel lining in accordance with Division 2 or as shown on the drawings.
- C. Provide clean cobbles and gravel consisting of crushed concrete or stone. Use clean, hard crushed concrete or stone free from adherent coatings, salt, alkali, dirt, clay, loam, shale, soft or flaky materials, or organic matter.
- D. Sediment Pump Pit Aggregate: Use nominal 2-inch diameter river gravel.

2.3 PIPE

- A. Polyethylene culvert pipe or PVC sewer pipe in accordance with Division 2 or as shown on the Drawings.
- B. Inlet Pipes: Galvanized steel pipe in accordance with Division 2 or as shown on the Drawings.
- C. Standpipe for Sediment Pump Pits: Galvanized round culvert pipe or round PVC pipe, minimum of 12-inch and a maximum of 24-inch diameter, perforate at 6 to 12 inch centers around circumference.

2.4 GEOTEXTILE FILTER FABRIC

- A. Woven or nonwoven geotextile filter fabric made of either polypropylene, polyethylene, ethylene, or polyamide material, in continuous rolls of longest practical length.
- B. Grab Strength: 100 psi in any principal direction (ASTM D-4632), Mullen burst strength >200 psi (ASTM D-3786), and equivalent opening size between 50 and 140.
- C. Furnish ultraviolet inhibitors and stabilizers for minimum 6 months of expected usable construction life at temperature range of 0 degrees F to 120 degrees F.
- D. Mirafi, Inc., Synthetic Industries, or equivalent.

2.5 FENCING

- A. Wire Fencing: Woven galvanized steel wire, 14 gauge by 6-inch square mesh spacing, minimum 24 inch roll or sheet width of longest practical length.
- B. Fence Stakes: Nominal 2 x 2 inch moisture-resistant treated wood or steel posts (min. of 1.25 lbs. per linear foot and Brinell Hardness greater than 140) with safety caps on top; length as required for minimum 8 inch bury and full height of filter fabric.

2.6 SANDBAGS

- A. Provide woven material made of polypropylene, polyethylene, or polyamide material.
 - 1. Minimum unit weight of four ounces per square yard.
 - 2. Minimum grab strength of 100 psi in any principal direction (ASTM D4632).
 - 3. Mullen burst strength exceeding 300 psi (ASTM D3786).
 - 4. Ultraviolet stability exceeding 70 percent.
 - 5. Size: Length: 18 to 24 inches. Width: 12 to 18 inches. Thickness: 6 to 8 inches. Weight: 50 to 125 pounds.

2.7 DROP INLET BASKET

- A. Provide steel frame members in accordance with ASTM A36.
- B. Construct top frame of basket with two short sides of 2 inch by 2 inch and single long side of 1 inch by 1 inch, 1/8 inch angle iron. Construct basket hangers of 2 inch by 1/4 inch iron bars. Construct bottom frame of 1 inch by 1/4 inch iron bar or 1/4 inch plate with center 3 inches removed. Use minimum 1/4 inch diameter iron rods or equivalent for sides of inlet basket. Weld minimum of 14 rods in place between top frame/basket hanger and bottom frame. Exact dimensions for top frame and insert basket will be determined based on dimensions of type of inlet being protected.

2.8 STRAW BALE

- A. Straw: Standard-baled agricultural hay bound by wire, nylon, or polypropylene rope. Do not use jute or cotton binding.
- B. Straw Bale Stakes (applicable where bales are on soil): No. 3 (3/8 diameter) reinforcing bars, deformed or smooth at Contractor's option, length as required for minimum 18 inch bury and full height bales.

PART 3 EXECUTION

3.1 PREPARATION, INSTALLATION AND MAINTAINANCE

- A. Provide erosion and sediment control structures at locations shown on the Drawings.
- B. Do not clear, grub or rough cut until erosion and sediment control systems are in place unless approved by Project Manger to allow installation of erosion and sediment control systems, soil testing and surveying.
- C. Maintain existing erosion and sediment control systems located within project site until acceptance of Project or until directed by Project Manger to remove and discard existing system.
- D. Regularly inspect and repair or replace damaged components of erosion and sediment control structures. Unless otherwise directed, maintain erosion and sediment control structure until project area stabilization is accepted. . Redress and replace granular fill at outlets as needed to replenish depleted granular fill. Remove erosion and sediment control structures promptly when directed by Project Manger. Dispose of materials in accordance with Division 1.

- E. Remove and dispose sediment deposits at the designated spoil site for the Project. If a project spoil site is not designated on Drawings, dispose of sediment off site at approved location in accordance with Division 1.
- F. Unless otherwise shown on the Drawings, compact embankments, excavations, and trenches in accordance with Division 2.
- G. Prohibit equipment and vehicles from maneuvering on areas outside of dedicated right of way and easements for construction. Immediately repair damage caused by construction traffic to erosion and sediment control structures.
- H. Protect existing trees and plants in accordance with Division 1.

3.2 SEDIMENT TRAPS

- A. Install sediment traps so that surface runoff shall percolate through system in sheet flow fashion and allow retention and accumulation of sediment.
- B. Inspect sediment traps after each rainfall, daily during periods of prolonged rainfall, and at a minimum once each week. Repair or replace damaged sections immediately.
- C. Use fill material for embankment in accordance with Division 2.
- D. Excavation length and height shall be as specified on Drawings. Use side slopes of 2:1 or flatter.
- E. Stone outlet sediment traps:
 - 1. Maintain minimum of 6 inches between top of core material and top of stone outlet, minimum of 4 inches between bottom of core material and existing ground and minimum of 1 foot between top of stone outlet and top of embankment.
 - 2. Embed cobbles minimum of 4 inches into existing ground for stone outlet. Core shall be minimum of 1 foot in height and in width and wrapped in triple layer of geotextile filter fabric.
- F. Sediment Basin with Pipe Outlet Construction Methods: Install outlet pipe and riser as shown on the Drawings.
- G. Remove sediment deposits when design basin volume is reduced by one-third or sediment level is one foot below principal spillway crest, whichever is less.

3.3 FILTER FABRIC FENCE CONSTRUCTION METHODS

- A. Fence Type 1
 - 1. Install stakes 3 feet on center maximum and firmly embed minimum 8 inches in soil. If filter fabric is factory pre-assembled with support netting, then maximum support spacing is 8 feet. Install wood stakes at a slight angle toward the source of anticipated runoff.
 - 2. Trench in the toe of the fence lines so the downward face of the trenches is flat and perpendicular to direction of flow. V-trench configuration as shown on Drawings may also be used.
 - 3. Lay fabric along edges of trenches in longest practical continuous runs to minimize joints. Make joints only at a support post. Splice with minimum 6-inch overlap and seal securely.
 - 4. Staple filter fabric to stakes at maximum 3 inches on center. Extend fabric minimum 18 inches and maximum 36 inches above natural ground.
 - 5. Backfill and compact trench.

B. Fence Type 2

1. Layout fence same as for Type 1.
2. Install stakes at 6 feet on center maximum and at each joint in wire fence, firmly embedded 1-foot minimum, and inclined it as for Type 1.
3. Tie wire fence to stakes with wire at 6 inches on center maximum. Overlap joints minimum one bay of mesh.
4. Install trench same as for Type 1.
5. Fasten filter fabric wire fence with tie wires at 3 inches on center maximum.
6. Layout fabric same as for Type 1. Fasten to wire fence with wire ties at 3 inches on center maximum and, if applicable, to stakes above top of wire fence it as for Type 1.
7. Backfill and compact trench.

C. Attach filter fabric to wooden fence stakes spaced a maximum of 6 feet apart or steel fence stakes spaced a maximum of 8 feet apart and embedded a minimum of 12 inches. Install stakes at a slight angle toward source of anticipated runoff.

D. Trench in toe of filter fabric fence with spade or mechanical trencher so that downward face of trench is flat and perpendicular to direction of flow. A V-trench configuration may also be used. Lay filter fabric along edges of trench. Backfill and compact trench upon completion of Construction.

E. Filter fabric fence shall have a minimum height of 18 inches and a maximum height of 36 inches above natural ground.

F. Cut length of fence to minimize use of joints. When joints are necessary, splice fabric together only at support post with minimum 6 inch overlap and seal securely.

G. Triangular Filter Fabric Fence Construction Methods

1. Attach filter fabric to wire fencing, 18 inches on each side. Provide a fabric cover and skirt with continuous wrapping of fabric. Skirt should form continuous extension of fabric on upstream side of fence.
2. Secure triangular fabric filter fence in place using one of the following methods:
 - a. Toe-in skirt 6 inches with mechanically compacted material;
 - b. Weight down skirt with continuous layer of 3-inch to 5-inch graded rock; or
 - c. Trench-in entire structure 4 inches.
3. Anchor triangular fabric filter fence structure and skirt securely in place using 6-inch wire staples on 2-foot centers on both edges and on skirt, or staked using 18-inch by 3/8-inch diameter re-bar with tee ends.
4. Lap fabric filter material by 6 inches to cover segment joints. Fasten joints with galvanized shoat rings.

H. Reinforced Filter Fabric Barrier Construction Methods

1. Attach woven wire fence to fence stakes.
2. Securely fasten filter fabric material to wire fence with tie wires.
3. When used in swales, ditches or diversions, elevation of barrier at top of filter fabric at flow line location in channel shall be lower than bottom elevation of filter fabric at ends of barrier or top of bank, whichever is less, in order to keep storm water discharge in channel from overtopping bank.
4. Remove sediment deposits when silt reaches depth one-third height of barrier or 6 inches, whichever is less.

3.4 DIKE AND SWALE

- A. Unless otherwise indicated, maintain minimum dike height of 18 inches, measured from cleared ground at up slope toe to top of dike. Maintain side slopes of 2:1 or flatter.
- B. Dike and Swale Stabilization: When shown on the Drawings, place gravel lining 3 inches thick and compacted into the soil or 6 inches thick if truck crossing is expected. Extend gravel lining across bottom and up both sides of swale minimum height of 8 inches vertically, above bottom. Gravel lining on dike side shall extend up the up slope side of dike a minimum height of 8 inches, measured vertically from interface of existing or graded ground and up slope toe of dike, as shown on Drawings.
- C. Divert flow from dikes and swales to sediment basins, stabilized outlets, or sediment trapping devices of types and at locations shown on Drawings. Grade dikes and swales as shown on Drawings, or, if not specified, provide positive drainage with maximum grade of 1 percent to outlet or basin.
- D. Clear in accordance with Division 2.
- E. Carry out excavation for swale construction so that erosion and water pollution is minimal. Minimum depth shall be 1 foot and bottom width shall be 4 feet, with level swale bottom. Excavation slopes shall be 2:1 or flatter. Clear, grub and strip excavation area of vegetation and root material.

3.5 DOWN SPOUT EXTENDER

- A. Down spout extender shall have slope of approximately 1 percent. Use pipe diameter of 4 inches or as shown on the Drawings. Place pipe in accordance with Division 2.

3.6 PIPE SLOPE DRAIN

- A. Compact soil around and under drain entrance section to top of embankment in lifts appropriately sized for method of compaction utilized.
- B. Inlet pipe shall have slope of 1 percent or greater. Use pipe diameter as shown on the Drawings.
- C. Top of embankment over inlet pipe and embankments directing water to pipe shall be at least 1 foot higher at all points than top of inlet pipe.
- D. Pipe shall be secured with hold-down grommets spaced 10 feet on centers.
- E. Place riprap apron with a depth equal to pipe diameter with 2:1 side slopes.

3.7 PAVED FLUME

- A. Compact soil around and under the entrance section to top of the embankment in lifts appropriately sized for method of compaction utilized.
- B. Construct subgrade to required elevations. Remove and replace soft sections and unsuitable material. Compact subgrade thoroughly and shape to a smooth, uniform surface.
- C. Construct permanent paved flumes in accordance with Drawings.
- D. Remove sediment from riprap apron when sediment has accumulated to depth of one foot.

3.8 LEVEL SPREADER

- A. Construct level spreader on undisturbed soil and not on fill. Ensure that spreader lip is level for uniform spreading of storm runoff.
- B. Maintain at required depth, grade, and cross section as specified on Drawings. Remove sediment deposits as well as projections or other irregularities which will impede normal flow.

3.9 INLET PROTECTION BARRIER

- A. Place sandbags and filter fabric fences at locations shown on the SWP3.

3.10 DROP INLET BASKET CONSTRUCTION METHODS.

- A. Fit inlet insert basket into inlet without gaps around insert at locations shown on the SWP3.
- B. Support for inlet insert basket shall consist of fabricated metal as shown on Drawings.
- C. Push down and form filter fabric to shape of basket. Use sheet of fabric large enough to be supported by basket frame when holding sediment and extend at least 6 inches past frame. Place inlet grates over basket/frame to serve as fabric anchor.
- D. Remove sediment deposit after each storm event and whenever accumulation exceeds 1-inch depth during weekly inspections.

3.11 STRAW BALE FENCE CONSTRUCTION METHODS

- A. Place bales in row with ends tightly abutting adjacent bales. Place bales with bindings parallel to ground surface.
- B. Embed bale in soil a minimum of 4 inches.
- C. Securely anchor bales in place with Straw Bale Stakes driven through bales a minimum of 18-inches into ground. Angle first stake in each bale toward previously laid bale to force bales together.
- D. Fill gaps between bales with straw to prevent water from channeling between bales. Wedge carefully in order not to separate bales.
- E. Replace with new straw bale fence every two months or as required by Owner's Representative.

3.12 BRUSH BERM CONSTRUCTION METHODS

- A. Construct brush berm along contour lines by hand placing method. Do not use machine placement of brush berm.
- B. Use woody brush and branches having diameter less than 2-inches with 6-inches overlap. Avoid incorporation of annual weeds and soil into brush berm.
- C. Use minimum height of 18-inches measured from top of existing ground at upslope toe to top of berm. Top width shall be 24 inches minimum and side slopes shall be 2:1 or flatter.
- D. Embed brush berm into soil a minimum of 4-inches and anchor using wire, nylon or polypropylene rope across berm with a minimum tension of 50 pounds. Tie rope securely to 18-inch x 3/8-inch diameter rebar stakes driven into ground on 4-foot centers on both sides of berm.

3.13 STREET AND SIDEWALK CLEANING

- A. Keep areas clean of construction debris and mud carried by construction vehicles and equipment. If necessary, install stabilized construction exits at construction, staging, storage, and disposal areas, following Division 1.
- B. In lieu of or in addition to stabilized construction exits, shovel or sweep pavements as required to keep areas clean. Do not water hose or sweep debris and mud off street into adjacent areas, except, hose sidewalks during off-peak hours, after sweeping.

3.14 WASTE COLLECTION AREAS

- A. Prevent water runoff from passing through waste collection areas, and prevent water runoff from waste collection areas migrating outside collection areas.

3.15 EQUIPMENT MAINTENANCE AND REPAIR

- A. Confine maintenance and repair of construction machinery and equipment to areas specifically designated for that purpose, so fuels, lubricants, solvents, and other potential pollutants are not washed directly into receiving streams or storm water conveyance systems. Provide these areas with adequate waste disposal receptacles for liquid and solid waste. Clean and inspect maintenance areas daily.
- B. Where designated equipment maintenance areas are not feasible, take precautions during each individual repair or maintenance operation to prevent potential pollutants from washing into streams or conveyance systems. Provide temporary waste disposal receptacles.

3.16 VEHICLE/ EQUIPMENT WASHING AREAS

- A. Install wash area (stabilized with coarse aggregate) adjacent to stabilized construction exit(s), as required to prevent mud and dirt run-off. Release wash water into drainage swales or inlets protected by erosion and sediment controls. Build wash areas following Division 1. Install gravel or rock base beneath wash areas.
- B. Wash vehicles only at designated wash areas. Do not wash vehicles such as concrete delivery trucks or dump trucks and other construction equipment at locations where runoff flows directly into watercourses or storm water conveyance systems.
- C. Locate wash areas to spread out and evaporate or infiltrate wash water directly into ground, or collect runoff in temporary holding or seepage basins.

3.17 WATER RUNOFF AND EROSION CONTROL

- A. Control surface water, runoff, subsurface water, and water from excavations and structures to prevent damage to the Work, the site, or adjoining properties.
- B. Control fill, grading and ditching to direct water away from excavations, pits, tunnels, and other construction areas, and to direct drainage to proper runoff courses to prevent erosion, sedimentation or damage.
- C. Provide, operate, and maintain equipment and facilities of adequate size to control surface water.
- D. Dispose of drainage water to prevent flooding, erosion, or other damage to the site or adjoining areas. Follow environmental requirements.

- E. Retain existing drainage patterns external to the site by constructing temporary earth berms, sedimentation basins, retaining areas, and temporary ground cover as required to control conditions.
- F. Plan and execute construction and earth work to control surface drainage from cuts and fills, and from borrow and waste disposal areas, to prevent erosion and sedimentation.
 - 1. Hold area of bare soil exposed at one time to a minimum.
 - 2. Provide temporary controls such as berms, dikes, and drains.
- G. Construct fill and waste areas by selective placement to eliminate surface silts or clays which will erode.
- H. Inspect earthwork periodically to detect start of erosion. Immediately apply corrective measures as required to control erosion.
- I. Dispose of sediments offsite, not in or adjacent to streams or floodplains, nor allow sediments to flush into streams or drainage ways. Assume responsibility for offsite disposal location.
- J. Unless otherwise indicated, compact embankments, excavations, and trenches by mechanically blading, tamping, and rolling soil in maximum of 8-inch layers. Provide compaction density at minimum 90 percent Standard Proctor ASTM D-698-78 density. Make at least one test per 500 cubic yards of embankment.
- K. Do not maneuver vehicles on areas outside of dedicated rights-of-way and easements for construction. Immediately repair damage to erosion and sedimentation control systems caused by construction traffic.
- L. Do not damage existing trees intended to remain.

3.18 REMOVAL OF CONTROLS

- A. Remove erosion and sediment controls when the site is finally stabilized or as directed by Owner's Representative.
- B. Dispose of sediments and waste products following Division 1.

END OF SECTION

SECTION 01 57 23.10 - TPDES REQUIREMENTS

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Documentation to be prepared and signed by Contractor before conducting construction operations, in accordance with the Texas Pollutant Discharge Elimination System (TPDES) Construction General Permit Number TXR 150000 (the Construction General Permit).
- B. Implementation, maintenance inspection, and termination of storm water pollution prevention control measures including, but not limited to, erosion and sediment controls, storm water management plans, waste collection and disposal, off-site vehicle tracking, and other appropriate practices shown on the Drawings or specified elsewhere in the Contract.
- C. Review of the Storm Water Pollution Prevention Plan (SWP3) implementation in a meeting with the Owner's Representative prior to start of construction.

1.2 DEFINITIONS

- A. Commencement of Construction Activities: The exposure of soil resulting from activities such as clearing, grading, and excavating.
- B. Large Construction Activity: Project that:
 - 1. Disturbs five acres or more, or
 - 2. Disturbs less than five acres but is part of a larger common plan of development that will disturb five acres or more of land.
- C. Small Construction Activity: Project that:
 - 1. Disturbs one or more acres but less than five acres, or
 - 2. Disturbs less than one acre but is part of a larger common plan of development that will ultimately disturb one or more acres but less than five acres.
- D. TPDES Operator:
 - 1. The person or persons who have day-to-day operational control of the construction activities which are necessary to ensure compliance with the SWP3 for the site or other Construction General Permit conditions.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION

3.1 SITE SPECIFIC STORM WATER POLLUTION PREVENTION PLAN (SWP3)

- A. Prepare a SWP3 following Part III of the Construction General Permit and the applicable local code. If conflicts exist between the Construction General Permit and the local regulations, the more stringent requirements will apply.
- B. Update or revise the SWP3 as needed during the construction following Part III, Section E of the Construction General Permit.

- C. Submit the SWP3 and any updates or revisions to the Owner's Representative for review and address comments prior to commencing, or continuing, construction activities.

3.2 NOTICE OF INTENT FOR LARGE CONSTRUCTION ACTIVITY

- A. Fill out, sign, and date TCEQ Form 20022 Notice of Intent (NOI) for Storm Water Discharges Associated with Construction Activity under the TPDES Construction General Permit (TXR 150000).
- B. Transmit the signed Contractor's copy of TCEQ Form 20022, along with a check for the required fee, made out to Texas Commission on Environmental Quality.
- C. Submission of the Notice of Intent form by the Contractor to TCEQ is required a minimum of two days before Commencement of Construction Activities.

3.3 CONSTRUCTION SITE NOTICE FOR SMALL CONSTRUCTION ACTIVITY

- A. Fill out, sign, and date the Construction Site Notice, Attachment 2 to TPDES General Permit TXR 150000, "Construction Site Notice."
- B. Transmit the signed Construction Site Notice to the Engineer at least seven days prior to Commencement of Construction Activity.

3.4 CERTIFICATION REQUIREMENTS

- A. Conduct inspections in accordance with TCEQ requirements. Ensure persons or firms responsible for maintenance and inspection of erosion and sediment control measures read, fill out, sign, and date the Erosion Control Contractor's Certification for Inspection and Maintenance. Use the EPA NPDES Construction Inspection Form

3.5 RETENTION OF RECORDS

- A. Keep a copy of this document and the SWP3 in a readily accessible location at the construction site from Commencement of Construction Activity until submission of the Notice of Termination (NOT) for Storm Water Discharges Associated with Construction Activity under TPDES Construction General Permit (TXR 150000). Contractors with day-to-day operational control over SWP3 implementation shall have a copy of the SWP3 available at a central location, on-site, for the use of all operators and those identified as having responsibilities under the SWP3. Upon submission of the NOT, submit all required forms and a copy of the SWP3 with all revisions to the Owner's Representative.

3.6 REQUIRED NOTICES

- A. Post the following notices from effective date of the SWP3 until date of final site stabilization as defined in the Construction General Permit:
 - 1. Post the TPDES permit number for Large Construction Activity, or a signed TCEQ Construction Site Notice for Small Construction Activity. A signed copy of the Contractor's NOI must also be posted.
 - 2. Post notices near the main entrance of the construction site in a prominent place for public viewing. Post name and telephone number of Contractor's local contact person, brief project description and location of the SWP3.
 - a. If posting near a main entrance is not feasible due to safety concerns, coordinate posting of notice with the Owner's Representative to conform to requirements of the Construction General Permit.

- b. If Project is a linear construction project (e.g.: road, utilities, etc.), post notice in a publicly accessible location near active construction. Move notice as necessary.
3. Post a notice to equipment and vehicles operators, instructing them to stop, check, and clean tires of debris and mud before driving onto traffic lanes. Post at each stabilized construction exit area.
4. Post a notice of waste disposal procedures in a readily visible location on site.

3.7 ON-SITE WASTE MATERIAL STORAGE

- A. On-site waste material storage shall be self-contained and shall satisfy appropriate local, state, and federal rules and regulations.
- B. Prepare list of waste material to be stored on-site. Update list as necessary to include up-to-date information. Keep a copy of updated list with the SWP3.
- C. Prepare description of controls to reduce pollutants generated from on-site storage. Include storage practices necessary to minimize exposure of materials to storm water, and spill prevention and response measures consistent with best management practices. Keep a copy of the description with the SWP3.

3.8 NOTICE OF TERMINATION

- A. Submit a NOT to TCEQ and the Engineer within 30 days after:
 1. Final stabilization has been achieved on all portions of the site that are the responsibility of the Contractor; or
 2. Another operator has assumed control over all areas of the site that have not been stabilized; and
 3. All silt fences and other temporary erosion controls have either been removed, scheduled to be removed as defined in the SWP3, or transferred to a new operator if the new operator has sought permit coverage.

END OF SECTION

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SECTION 01 57 23.11 - STABILIZED CONSTRUCTION EXIT

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Installation of erosion and sediment control for stabilized construction exits used during construction and until final development of the site.

1.2 SUBMITTALS

- A. Manufacturer's catalog sheets and other product data on geotextile fabric.
- B. Sieve analysis of aggregates conforming to requirements of this Specification.

1.3 UNIT PRICES

- A. Unless indicated in the Unit Price Schedule as a pay item, no separate payment will be made for work performed under this Section. Include cost of work performed under this Section in pay items for which this work is a component.
- B. When indicated in the Unit Price Schedule, include stabilized exits under payment for Street Cleaning as Required by NPDES, including stabilized construction roads, parking areas, exits, and truck washing areas will include and be full compensation for all labor, equipment, materials, supervision, and all incidental expenses for construction of these items, complete in place, including, but not limited to, embankment and excavation, maintenance requirements, repair and replacement of damaged sections, removal of sediment deposits, redressing of aggregates and stones, cleaning of streets, and removal of erosion and sediment control systems at the end of construction.

1.4 REFERENCES

- A. ASTM D 4632 - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.

PART 2 PRODUCTS

2.1 GEOTEXTILE FABRIC

- A. Provide woven or nonwoven geotextile fabric made of either polypropylene, polyethylene, ethylene, or polyamide material.
- B. Geotextile fabric shall have a minimum grab strength of 270 psi in any principal direction (ASTM D-4632), and the equivalent opening size between 50 and 140.
- C. Both the geotextile and threads shall be resistant to chemical attack, mildew, and rot and shall contain ultraviolet ray inhibitors and stabilizers to provide a minimum of 6 months of expected usable life at a temperature range of 0°F to 120°F.
- D. Representative Manufacturers: Mirafi, Inc., or equal.

2.2 COARSE AGGREGATES

- A. Coarse aggregate shall consist of crushed stone, gravel, crushed blast furnace slag, or a combination of these materials. Aggregate shall be composed of clean, hard, durable materials free from adherent coatings, salt, alkali, dirt, clay, loam, shale, soft or flaky materials, or organic and injurious matter.
- B. Coarse aggregates shall conform to the following gradation requirements.

| <u>Sieve Size (Square Mesh)</u> | <u>Percent Retained (By Weight)</u> |
|-------------------------------------|---|
| 2-1/2" | 0 |
| 2" | 0 - 20 |
| 1-1/2" | 15 - 50 |
| 3/4" | 60 - 80 |
| No. 4 | 95 - 100 |

PART 3 EXECUTION

3.1 PREPARATION AND INSTALLATION

- A. If necessary to keep the street clean of mud carried by construction vehicles and equipment, Contractor shall provide stabilized construction roads and exits at the construction, staging, parking, storage, and disposal areas. Such erosion and sediment controls shall be constructed in accordance with the requirements shown on the Drawings and specified in this Section.
- B. No clearing and grubbing or rough cutting shall be permitted until erosion and sediment control systems are in place, other than as specifically directed by the Owner's Representative to allow soil testing and surveying.
- C. Maintain existing erosion and sediment control systems located within the project site until acceptance of the project or until directed by the Owner's Representative to remove and discard the existing system.
- D. Regularly inspect and repair or replace components of stabilized construction exits. Unless otherwise directed, maintain the stabilized construction roads and exits until the project is accepted by the Owner. Remove stabilized construction roads and exits promptly when directed by the Owner's Representative. Discard removed materials off site in accordance with the requirements of Division 1.
- E. Remove sediment deposits and dispose of them at the designated spoil site for the project. If a project spoil site is not designated on the Drawings, dispose of sediment off site at location not in or adjacent to a stream or floodplain. Off-site disposal is the responsibility of the Contractor. Sediment to be placed at the project site should be spread evenly throughout the site, compacted and stabilized. Sediment shall not be allowed to flush into a stream or drainage way. If sediment has been contaminated, it shall be disposed of in accordance with existing federal, state, and local rules and regulations.
- F. Equipment and vehicles shall be prohibited by the Contractor from maneuvering on areas outside of dedicated rights-of-way and easements for construction. Damage caused by construction traffic to erosion and sediment control systems shall be repaired immediately.
- G. Conduct all construction operation under this Contract in conformance with the erosion control practices described in Division 1.

3.2 CONSTRUCTION METHODS

- A. Provide stabilized access roads, subdivision roads, parking areas, and other on-site vehicle transportation routes where shown on Drawings.
- B. Provide stabilized construction exits, and truck washing areas when approved by Owner's Representative, of the sizes and locations where shown on Drawings or as specified in this Section.
- C. Vehicles leaving construction areas shall have their tires cleaned to remove sediment prior to entrance onto public right-of-way. When washing is needed to remove sediment, Contractor shall construct a truck washing area. Truck washing shall be done on stabilized areas which drain into a drainage system protected by erosion and sediment control measures.
- D. Details for stabilized construction exit are shown on the Drawings. Construction of all other stabilized areas shall be to the same requirements. Roadway width shall be at least 14 feet for one-way traffic and 20 feet for two-way traffic and shall be sufficient for all ingress and egress. Furnish and place geotextile fabric as a permeable separator to prevent mixing of coarse aggregate with underlying soil. Exposure of geotextile fabric to the elements between laydown and cover shall be a maximum of 14 days to minimize damage potential.
- E. Roads and parking areas shall be graded to provide sufficient drainage away from stabilized areas. Use sandbags, gravel, boards, or similar methods to prevent sediment from entering public right-of-way, receiving stream or storm water conveyance system.
- F. The stabilized areas shall be inspected and maintained daily. Provide periodic top dressing with additional coarse aggregates to maintain the required depth. Repair and clean out damaged control measures used to trap sediment. All sediment spilled, dropped, washed, or tracked onto public right-of-way shall be removed immediately.
- G. The length of the stabilized area shall be as shown on the Drawings, but not less than 50 feet. The thickness shall not be less than 8 inches. The width shall not be less than the full width of all points of ingress or egress.
- H. Stabilization for other areas shall have the same coarse aggregate, thickness, and width requirements as the stabilized construction exit, except where shown otherwise on the Drawings.
- I. Stabilized area may be widened or lengthened to accommodate truck washing area when authorized by Owner's Representative.
- J. Alternative methods of construction may be utilized when shown on Drawings, or when approved by the City Engineer. These methods include the following:
 - 1. Cement-Stabilized Soil - Compacted cement-stabilized soil or other fill material in an application thickness of at least 8 inches.
 - 2. Wood Mats/Mud Mats - Oak or other hardwood timbers placed edge-to-edge and across support wooden beams which are placed on top of existing soil in an application thickness of at least 6 inches.
 - 3. Steel Mats - Perforated mats placed across perpendicular support members.

END OF SECTION

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SECTION 01 57 23.12 – CONTROL OF GROUND WATER

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Dewatering, depressurizing, draining, and maintaining trenches, shaft excavations, structural excavations and foundation beds in stable condition, and controlling ground water conditions for tunnel excavations.
- B. Protecting work against surface runoff and rising floodwaters.
- C. Trapping suspended sediment in the discharge from the surface and ground water control systems.

1.2 MEASUREMENT AND PAYMENT

A. UNIT PRICES

- 1. Measurement for control of ground water, if included in Bid Form, will be on either a lump sum basis or a linear foot basis for continuous installations of well points, eductor wells, or deep wells.
- 2. If not included in Bid Form, include the cost to control ground water in unit price for work requiring such controls.
- 3. No separate payment will be made for control of surface water. Include cost to control surface water in unit price for work requiring controls.
- 4. Follow Division 1 for unit price procedures.

- B. Stipulated Price (Lump Sum) Contract. If the Contract is a Stipulated Price Contract, include payment for work under this section in the total Stipulated Price.

1.3 REFERENCES

- A. ASTM D 698 - Standard Test Methods for Laboratory Compaction of Soils Using Standard Effort (12,400 ft-lbf/ft³ (600kN-m/m³))
- B. Federal Regulations, 29 CFR Part 1926, Standards-Excavation, Occupational Safety and Health Administration (OSHA)
- C. Storm Water Management Handbook for Construction Activities prepared by City of Houston, Harris County and Harris County Flood Control District.

1.4 DEFINITIONS

- A. Ground water control system: system used to dewater and depressurize water-bearing soil layers.
 - 1. Dewatering: lowering the water table and intercepting seepage that would otherwise emerge from slopes or bottoms of excavations, or into tunnels and shafts; and disposing of removed water. Intent of dewatering is to increase stability of tunnel excavations and excavated slopes, prevent dislocation of material from slopes or bottoms of excavations, reduce lateral loads on sheeting and bracing, improve excavating and hauling characteristics of excavated material, prevent failure or heaving of bottom of excavations,

- and to provide suitable conditions for placement of backfill materials and construction of structures and other installations.
2. Depressurization: includes reduction in piezometric pressure within strata not controlled by dewatering alone, necessary to prevent failure or heaving of excavation bottom or instability of tunnel excavations.
- B. Excavation drainage: includes keeping excavations free of surface and seepage water.
- C. Surface drainage: includes use of temporary drainage ditches and dikes and installation of temporary culverts and sump pumps with discharge lines necessary to protect Work from any source of surface water.
- D. Monitoring facilities for ground water control system: includes piezometers, monitoring wells and flow meters for observing and recording flow rates.

1.5 PERFORMANCE REQUIREMENTS

- A. Conduct subsurface investigations to identify groundwater conditions and to provide parameters for design, installation, and operation of groundwater control systems. Submit proposed method and spacing of readings for review prior to obtaining water level readings.
- B. Design ground water control system, compatible with requirements of Federal Regulations 29 CFR Part 1926 and Division 2 to produce following results:
1. Effectively reduce hydrostatic pressure affecting:
 - a. Excavations
 - b. Tunnel excavation, face stability or seepage into tunnels
 2. Develop substantially dry and stable subgrade for subsequent construction operations
 3. Preclude damage to adjacent properties, buildings, structures, utilities, installed facilities and other work
 4. Prevent loss of fines, seepage, boils, quick condition, or softening of foundation strata
 5. Maintain stability of sides and bottom of excavations
- C. Provide ground water control systems that include single-stage or multiple-stage well point systems, eductor and ejector-type systems, deep wells, or combinations of these equipment types.
- D. Provide drainage of seepage water and surface water, as well as water from other sources entering excavation. Excavation drainage may include placement of drainage materials, crushed stone and filter fabric, together with sump pumping.
- E. Provide ditches, berms, pumps and other methods necessary to divert and drain surface water from excavation and other work areas.
- F. Locate ground water control and drainage systems so as not to interfere with utilities, construction operations, adjacent properties, or adjacent water wells.
- G. Assume sole responsibility for ground water control systems and for any loss or damage resulting from partial or complete failure of protective measures and settlement or resultant damage caused by ground water control operations. Modify ground water control systems or operations if they cause or threaten to cause damage to new construction, existing site improvements, adjacent property, adjacent water wells, or potentially contaminated areas. Repair damage caused by ground water control systems or resulting from failure of system to protect property as required.

- H. Install an adequate number of piezometers installed at proper locations and depths, necessary to provide meaningful observations of conditions affecting excavation, adjacent structures and water wells.
- I. Install environmental monitoring wells at proper locations and depths necessary to provide adequate observations of hydrostatic conditions and possible contaminant transport from contamination sources into work area or ground water control system.

1.6 SUBMITTALS

- A. Conform to requirements of Division 1.
- B. Submit Ground Water and Surface Water Control Plan for review by Owner's Representative prior to start of excavation work. Include the following:
 - 1. Results of subsurface investigations and description of extent and characteristics of water bearing layers subject to ground water control
 - 2. Names of equipment Suppliers and installation Subcontractors
 - 3. Description of proposed ground water control systems indicating arrangement, location, depth and capacities of system components, installation details and criteria and operation and maintenance procedures
 - 4. Description of proposed monitoring facilities indicating depths and locations of piezometers and monitoring wells, monitoring installation details and criteria, type of equipment and instrumentation with pertinent data and characteristics
 - 5. Description of proposed filters including types, sizes, capacities and manufacturer's application recommendations
 - 6. Design calculations demonstrating adequacy of proposed systems for intended applications. Define potential area of influence of ground water control operation near contaminated areas.
 - 7. Operating requirements, including piezometric control elevations for dewatering and depressurization
 - 8. Excavation drainage methods including typical drainage layers, sump pump application and other means
 - 9. Surface water control and drainage installations
 - 10. Proposed methods and locations for disposing of removed water
- C. Submit following records upon completion of initial installation:
 - 1. Installation and development reports for well points, eductors, and deep wells
 - 2. Installation reports and baseline readings for piezometers and monitoring wells
 - 3. Baseline analytical test data of water from monitoring wells
 - 4. Initial flow rates
- D. Submit the following records weekly during control of ground and surface water operations:
 - 1. Records of flow rates and piezometric elevations obtained during monitoring of dewatering and depressurization. Refer to Paragraph 3.02, Requirements for Eductor, Well Points, or Deep Wells.
 - 2. Maintenance records for ground water control installations, piezometers and monitoring wells

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Comply with requirements of agencies having jurisdiction.
- B. Comply with Texas Commission on Environmental Quality regulations and Texas Water Well Drillers Association for development, drilling, and abandonment of wells used in dewatering system.
- C. Obtain necessary permits from agencies with jurisdiction over use of groundwater and matters affecting well installation, water discharge, and use of existing storm drains and natural water sources. Since review and permitting process may be lengthy, take early action to obtain required approvals.
- D. Monitor ground water discharge for contamination while performing pumping in vicinity of potentially contaminated sites.

PART 2 PRODUCTS

2.1 EQUIPMENT AND MATERIALS

- A. Select equipment and materials necessary to achieve desired results for dewatering. Selected equipment and materials are subject to review by Owner's Representative through submittals required in Paragraph 1.06, Submittals.
- B. Use experienced contractors, regularly engaged in ground water control system design, installation, and operation, to furnish and install and operate eductors, well points, or deep wells, when needed.
- C. Maintain equipment in good repair and operating condition.
- D. Keep sufficient standby equipment and materials available to ensure continuous operation, where required.
- E. Portable Sediment Tank System: Standard 55-gallon steel or plastic drums, free of hazardous material contamination.
 - 1. Shop or field fabricate tanks in series with main inlet pipe, inter-tank pipes and discharge pipes, using quantities sufficient to collect sediments from discharge water.

PART 3 EXECUTION

3.1 GROUND WATER CONTROL

- A. Perform necessary subsurface investigation to identify water bearing layers, piezometric pressures and soil parameters for design and installation of ground water control systems. Perform pump tests, if necessary to determine draw down characteristics. Present results in the Ground Water and Surface Water Control Plan submittal.
- B. Provide labor, material, equipment, techniques and methods to lower, control and handle ground water in manner compatible with construction methods and site conditions. Monitor effectiveness of installed system and its effect on adjacent property.

- C. Install, operate, and maintain ground water control systems in accordance with the Ground Water and Surface Water Control Plan. Notify Owner's Representative in writing of changes made to accommodate field conditions and changes to Work. Provide revised drawings and calculations with notification.
 - D. Provide continuous system operation, including nights, weekends, and holidays. Arrange appropriate backup if electrical power is primary energy source for dewatering system.
 - E. Monitor operations to verify systems lower ground water piezometric levels at rate required to maintain dry excavation resulting in stable subgrade for subsequent construction operations.
 - F. Depressurize zones where hydrostatic pressures in confined water bearing layers exist below excavations to eliminate risk of uplift or other instability of excavation or installed works. Define allowable piezometric elevations in the Ground Water and Surface Water Control Plan.
 - G. Removal of ground water control installations.
 - 1. Remove pumping system components and piping when ground water control is no longer required.
 - 2. Remove piezometers, including piezometers installed during design phase investigations and left for Contractor's use, upon completion of testing, as required in accordance with Part 3 of applicable specification.
 - 3. Remove monitoring wells when directed by Owner's Representative.
 - 4. Grout abandoned well and piezometer holes. Fill piping that is not removed with cement-bentonite grout or cement-sand grout.
 - H. During backfilling, maintain water level a minimum of 5 feet below prevailing level of backfill. Do not allow the water level to cause uplift pressures in excess of 80 percent of downward pressure produced by weight of structure or backfill in place. Do not allow water levels to rise into cement-stabilized sand until at least 48 hour after placement.
 - I. Provide uniform pipe diameter for each pipe drain run constructed for dewatering. Remove pipe drains when no longer required. If pipe removal is impractical, grout connections at 50-foot intervals and fill pipe with cement-bentonite grout or cement-sand grout after removal from service.
 - J. The extent of ground water control for structures with permanent perforated underground drainage systems may be reduced, for units designed to withstand hydrostatic uplift pressure. Provide a means to drain affected portions of underground systems, including standby equipment. Maintain drainage systems during construction operations.
 - K. Remove systems upon completion of construction or when dewatering and control of surface or ground water is no longer required.
 - L. Compact backfill to not less than 95 percent of maximum dry density in accordance with ASTM D 698.
 - M. Foundation Slab: Maintain saturation line at least 3 feet below lowest elevations where concrete is to be placed. Drain foundations in areas where concrete is to be placed before placing reinforcing steel. Keep free from water for 3 days after concrete is placed.
- 3.2 REQUIREMENTS FOR EDUCTOR, WELL POINTS, OR DEEP WELLS
- A. For aboveground piping in ground water control system, include a 12-inch minimum length of clear, transparent piping between each eductor well or well point and discharge header to allow visual monitoring of discharge from each installation.

- B. Install sufficient piezometers or monitoring wells to show that trench or shaft excavations in water bearing materials are pre-drained prior to excavation. Provide separate piezometers for monitoring of dewatering and for monitoring of depressurization. Install piezometers and monitoring wells for tunneling as appropriate for selected method of work.
- C. Install piezometers or monitoring wells at least one week in advance of the start of associated excavation.
- D. Dewatering may be omitted for portions of under drains or other excavations, where auger borings and piezometers or monitoring wells show that soil is pre-drained by existing systems and that ground water control plan criteria are satisfied.
- E. Replace installations that produce noticeable amounts of sediments after development.
- F. Provide additional ground water control installations, or change method of control if, ground water control plan does not provide satisfactory results based on performance criteria defined by plan and by specifications. Submit revised plan according to Paragraph 1.06B.

3.3 SEDIMENT TRAPS

- A. Install sediment tank as shown on approved plan.
- B. Inspect daily and clean out tank when one-third of sediment tank is filled with sediment.

3.4 SEDIMENT SUMP PIT

- A. Install sediment sump pits as shown on approved plan.
- B. Construct standpipe by perforating 12 inch to 24-inch diameter corrugated metal or PVC pipe.
- C. Extend standpipe 12 inches to 18 inches above lip of pit.
- D. Convey discharge of water pumped from standpipe to sediment trapping device.
- E. Fill sites of sump pits, compact to density of surrounding soil and stabilize surface when construction is complete.

3.5 EXCAVATION DRAINAGE

- A. Use excavation drainage methods if well-drained conditions can be achieved. Excavation drainage may consist of layers of crushed stone and filter fabric, and sump pumping, in combination with sufficient ground water control wells to maintain stable excavation and backfill conditions.

3.6 MAINTENANCE AND OBSERVATION

- A. Conduct daily maintenance and observation of piezometers or monitoring wells while ground water control installations or excavation drainage is operating at the site, or water is seeping into tunnels, and maintain systems in good operating condition.
- B. Replace damaged and destroyed piezometers or monitoring wells with new piezometers or wells as necessary to meet observation schedules.

- C. Cut off piezometers or monitoring wells in excavation areas where piping is exposed, only as necessary to perform observation as excavation proceeds. Continue to maintain and make specified observations.
- D. Remove and grout piezometers inside or outside of excavation area when ground water control operations are complete. Remove and grout monitoring wells when directed by Owner's Representative.

3.7 **MONITORING AND RECORDING**

- A. Monitor and record average flow rate of operation for each deep well, or for each wellpoint or eductor header used in dewatering system. Also, monitor and record water level and ground water recovery. Record observations daily until steady conditions are achieved and twice weekly thereafter.
- B. Observe and record elevation of water level daily as long as ground water control system is in operation, and weekly thereafter until Work is completed or piezometers or wells are removed, except when Owner's Representative determines more frequent monitoring and recording are required. Comply with Owner's Representative's direction for increased monitoring and recording and take measures necessary to ensure effective dewatering for intended purpose.

3.8 **SURFACE WATER CONTROL**

- A. Intercept surface water and divert it away from excavations through use of dikes, ditches, curb walls, pipes, sumps or other approved means. Requirement includes temporary works required to protect adjoining properties from surface drainage caused by construction operations.
- B. Divert surface water and seepage water into sumps and pump it into drainage channels or storm drains, when approved by agencies having jurisdiction. Provide settling basins when required by agencies.

END OF SECTION

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SECTION 01 71 23

FIELD ENGINEERING

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Measures to ensure adequate quality control and quality assurance for all Work in accordance with Conditions of the Contract, as specified herein, and with the quality control and quality assurance requirements of each Specification Section, and authorities having jurisdiction.

1.2 RELATED SECTIONS

- A. All Sections of Work requiring layout, survey, reference points and their verification and protection, and quality control and assurance monitoring requirements.

1.3 DEFINITIONS

- A. Survey and Field Engineering: Wherever the terms “Survey”, “Field Engineering” or any derivative thereof, or similar term appears within this Section, they mean one and the same, and shall mean the survey or field engineering work performed by the Field Engineer as defined below and is separate from that of the survey work provided by the Owner.
- B. Field Engineer: Wherever the term “Field Engineer” or any derivative thereof, or similar term appears in the Contract Documents, it shall refer to the General Contractor’s employee(s) that are expert in, routinely engaged in, and have at least five (5) years experience in, the practice of construction project field engineering, building and project layout, construction measurements and monitoring, etc.
- C. “Construction Surveyor”: Wherever the term “Construction Surveyor”, or any derivative thereof, or similar term appears in the Contract Documents, the entity (person or firm) licensed as a Registered Professional Land Surveyor or Professional Engineer of the discipline required for specific service on the Project in the State in which the Project occurs, with five (5) years minimum experience, and meeting all applicable regulations of the State in which the Project occurs and Department of Labor, and other authorities having jurisdiction to perform the Work. To avoid any misunderstanding or lack of interpretation, the entity responsible for performing the Work of this Section shall be employed by the General Contractor, and the responsibility, including methods and means, is totally that of the General Contractor.
- D. Quality Control and Quality Assurance: Wherever the terms “Quality Control”, “Quality Assurance” or any derivative thereof, or similar term appears in the Contract Documents, they mean one and the same, and shall mean an aggregate of activities of the General Contractor, such as design analysis and statistical sampling with inspection for defects, designed to ensure adequate quality in materials and workmanship whether factory manufactured or jobsite produced.

1.4 QUALITY CONTROL AND QUALITY ASSURANCE

- A. Employ a Construction Surveyor complying with the definition above and acceptable to the Owner and Architect, to perform all Construction Surveying. Provide full responsibility for the Construction Surveyor and accuracy of the performance of all items of Work shown on Drawings, specified herein, or in other Specification Sections.

SUBMITTALS FOR REVIEW

- A. Submit name, address, telephone number, fax number, and registration number of the proposed Construction Surveyor prior to starting Work of this Section.
- B. Submit evidence of Construction Surveyor's Errors and Omissions insurance coverage in the form of an Insurance Certificate, if different from Construction Manager's.
- C. Upon request by Architect, submit documentation verifying accuracy of all Survey Work, including a certificate sealed and signed by the Construction Surveyor, that the elevations and locations of the Work are in conformance with Contract Documents and such information has been incorporated into the Project Record Documents.
- D. Submit Project Record Documents under provisions of Section 01 77 00, Closeout Procedures.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify locations of survey control points prior to starting work.
- B. Promptly notify Architect of discrepancies discovered.

3.2 SURVEY REFERENCE POINTS

- A. Locate and protect survey control and reference points.
- B. Control datum for survey is that established by the Owner provided survey and as indicated on Drawings.
- C. Protect survey control points prior to starting site work; preserve permanent reference points during construction.
- D. Promptly report to Architect the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.
- E. Replace dislocated survey control points based on original Owner's survey control. Make no changes without prior written permission of Architect.

3.3 FIELD ENGINEERING AND CONSTRUCTION SURVEYOR REQUIREMENTS

- A. Establish a minimum of two (2) permanent benchmarks on site, referenced to established control points. Record locations, with horizontal and vertical data, on Project Record Documents.
- B. Field Engineer shall establish elevations, lines and levels. Locate, lay out, and monitor by instrumentation and similar appropriate means Work, including, but not be limited to:
 - 1. elevations, and layout of property lines and easements;
 - 2. site drainage, including storm water control and pollution prevention measures, slopes, swales, and invert elevations;
 - 3. limits of clearing and grubbing, including identification of trees and planting to be removed and methods for protection of those to remain;

4. excavations, fill and topsoil placement, and all (rough and finish) grades;
 5. trenching and trench safety;
 6. utility locations;
 7. concrete and asphaltic concrete paving, curbs, ramps, and other site improvements, as applicable;
 8. grid or axis for structures, batter board locations;
 9. elevation, grade controls, and layout of building foundation and grade beams, column locations, base plates, embedded items, depressions, formwork, and openings in concrete, including all interior finish grades;
 10. elevations of structural steel, including, steel joists/trusses, steel decks, and associated miscellaneous metals;
 11. elevations and layout of masonry, including concrete masonry units (CMU), face brick, cast stone, and other elements built-in masonry.
 12. elevations and slopes of roofing, including those for lightweight insulating concrete deck system, if applicable.
 13. elevations and layout of work as required to ensure proper operation, clearances, and tolerances, including conveying systems, plumbing and mechanical work; and
 14. monitoring of movement and protection of existing or adjacent structures, as applicable.
- C. Throughout course of Work, verify existing conditions and layouts by same means as originally used to ensure conformance with design requirements and details. Notify Architect immediately, if discrepancies are found.
- D. Provide one (1) copy each of reduced Field Engineer's notes to the Architect, Owner, Construction Surveyor, and affected Consultant within four (4) working days of completion of each portion of the Field Engineering Work.
- E. Field Engineer's notes shall be clear and complete. The Field Engineer shall be available at no expense to the Owner, Architect, or Consultants for note interpretation, if required.
- F. Field Engineer shall perform surveys to determine quantities of unit cost work, including control surveys to establish measurement reference lines. Notify Architect prior to starting work.
- G. Provide Construction Surveying services. Utilize recognized engineering survey practices.
- H. Construction Surveyor shall verify and record/document their findings, on a drawn survey at a scale matching that of the original Contract Documents, for the following:
1. All property lines and corners
 2. All building corners
 3. All paving corners
 4. Finish floor of all/each buildings
 5. Invert elevations, flow lines for all site drainage structures and improvements
- I. Payment for earthwork quantities shall be for materials in place, compacted, and determined by neat line method.
- J. Provide the Owner a reproducible hard copy and digital/electronic file copy of all the Construction Surveyor's work.

3.4 PROJECT RECORD DOCUMENTS

- A. Maintain a complete and accurate log of control and Field Engineer work as it progresses.
- B. Upon completion of Work, including, but not limited to earthwork, formwork, foundation, structural steel erection, and major site improvements, prepare Project Record Documents illustrating dimensions, locations, angles, and elevations of construction and site work.
- C. Submit Project Record Documents as specified in Paragraph 1.5.

END OF SECTION

SECTION 01 71 50

PREVENTIVE HOUSEKEEPING AND FINAL CARPET CLEANING

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 SCOPE OF WORK

- A. Cleaning of new and existing Tandus Powerbond carpet within the Project work area at the end of each work window upon substantial completion of work scheduled each day. Work window shall be determined by and coordinated with Owner.
- B. Clean entire area of building where construction or scope of work occurs, and all areas affected by construction activities including but not limited to dirt, debris and construction dust.
- C. Preventive Daily Housekeeping. The following are intended as a guide to facilitate the daily maintenance and cleanliness of the construction site, including but not limited to:
 - 1. Renovations involving the commons cafeteria where the stage curtain may be exposed/soiled by construction materials, dirt, dust etc. the curtain shall be removed prior to construction and stored according to curtain Manufacturer's recommended procedures and methods. Contractor reinstall after final cleaning. Contractor is responsible for curtain cleaning should it become soiled from construction activities per Curtain Manufacturer's methods.
 - 2. Contractor to segregate phased and/or areas of construction from all other areas of the building with a sealed, airtight construction barrier.
 - 3. Contractor shall provide additional AHU air filtration to protect existing Owner HVAC systems and other areas of building from becoming soiled from construction activities and dust. Should construction dirt and dust accumulate in affected construction areas, Contractor shall provide final cleaning of those spaces.
 - 4. Contractor is to prevent daily accumulation of construction dust or any other material that can cause any safety hazard.
 - 5. Contractor to eliminate, as practical as possible, tracking of dirt and debris prior to entering building each time.
 - 6. In an effort to protect existing flooring surfaces, Contractor is responsible for providing adhesive plastic sheeting and Masonite and/or plywood to prevent accumulation of all contaminants, including but not limited to: dirt, damaging foot traffic, lift equipment, machinery oil, etc. Continuously inspect and provide replacement/maintenance as needed of sheeting and Masonite/plywood as appropriate to construction intensity.
 - 7. Daily cleaning and maintenance of existing carpet to utilize procedure itemized in subsection 3.1 prior to cold water extraction.

PART 2 – PRODUCTS

2.1 CERTIFIED MAINTENANCE PARTNERS

- A. Corporate Care
Phone: 713-692-6300
Attn: Sean Barnett
- B. GCA Services Group
Phone: 972-276-5858
Attn: Dub Spencer

- C. Texan Floor Service
Phone: 713-956-9966
Attn: Jeff Hill

2.2 MATERIALS

- A. Cleaning Solutions: Cleaning solutions shall be used according to manufacturer's instructions. Review the material safety data sheets (MSDS) and/or safety data sheet (SDS), and product labels on solutions, being aware of any precautions and usage guidelines.
 - 1. Below are the minimum requirements for cleaning solutions to be used on C&A carpet. Contact your supplier to assure that these guidelines are met:
 - a. Shall be safe and non-toxic.
 - b. Shall contain no optical brighteners.
 - c. Shall have a pH between 5 and 9 diluted for normal cleaning.
 - d. Do not leave a sticky or oily residue when dried.
 - e. Will not damage carpet's fiber or color.
 - f. Will not promote rapid soiling.
 - 2. Conduct the following test to evaluate the type of residue a solution leaves behind:
 - a. Prepare the solution and pour in a pan.
 - b. Place in direct sunlight and allow to evaporate. If it leaves a sticky or oily residue, do not use. The carpet manufacturer can provide approved cleaning agents and deodorizers for the specific carpet. These cleaners have been tested for appropriate pH levels, absence of optical brighteners and zero resoil potential.

2.3 EQUIPMENT

- A. Equipment: Use the effective, well-functioning equipment:
 - 1. Vacuum Cleaner: Use a commercial vacuum cleaner that exceeds the established industry standards for soil removal. For improved indoor air quality, the vacuum shall have high efficiency filtration and shall emit minimal particles into the air. (The carpet manufacturer can provide a list of suggested vacuum cleaners.)
 - 2. Pile Lifter: Use a pile lifter to assist in the cleaning process to aggressively lift the pile fiber and loosen attached soil prior to vacuuming. Because of this aggressiveness, caution must be used when cleaning C&A's Syntex® products. (The carpet manufacturer can provide a list of suggested pile lifters.)
 - 3. Extractors: Provide hot water extraction for final deep cleaning and maintenance.
 - a. Selection should be based upon the needs of the facility. In general, the following minimum performance should be considered:
 - 1) Extractor should be C&A approved and capable of extracting a maximum volume of water injected into carpet pile fiber.
 - 2) Components should be made of a material that is non-corrosive and will not rust or deteriorate in the presence of water and/or cleaning solutions.
 - 3) Extractor should be able to generate a minimum of 50 pounds per square inch (psi) of pressure and should not exceed 400 psi.
 - 4) The carpet manufacturer can provide a list of suggested extractors.
 - 4. Portable Air Mover:
 - a. Carpet can dry within 2 to 3 hours in most environments. Drying time should never exceed 12 hours.
 - b. When extreme environmental conditions exist (relative humidity exceeds 65%), an air mover or drying fan should be used to accelerate drying time.
 - c. The carpet manufacturer can provide a list of suggested portable air movers

PART 3 – EXECUTION

3.1 PROCEDURE

- A. Cleaning Procedures:
1. Vacuuming
 - a. Make sure the vacuum cleaner is in proper working order before each use. (Clean all components regularly.)
 - b. Use slow, overlapping passes. Slowing the vacuum down allows the suction to loosen and remove the embedded dry soil that can abrade and damage fibers.
 - c. Pay careful attention to the “pull” stroke. More soil is removed in this action than in the forward stroke.
 - d. Empty vacuum bags when they become half full to improve soil removal.
 - e. Replace nylon brushes at the first sign of wear.
 - f. Use only original equipment manufacturer parts for consistent performance.
 2. Spill Removal
 - a. Spills may require cleaning solutions to remove.
 - b. The spill/liquid should be blotted into paper or cloth towels.
 - c. Place several layers of towels over the spill and apply pressure until all of the excess liquid has been removed.
 - d. Use a portable spot removal extractor with cold water solution.
 3. Spot Removal
 - a. Determine if the spot is a water-soluble or oil-based stain by applying clean water and blot with absorbent towel. Water-soluble spots will transfer to the towel; oil-based spots will not. Clean spot using one of the following methods:
 - 1) For water-based spots: Continue rinsing with water as long as there is transfer to the towel. A cleaning agent may not be necessary if water continues to remove the spot. If a cleaning agent is needed, apply a Manufacturer approved (Collins and Aikman for TanduS carpets) spot lifter to the area and allow to soak for 5 minutes. Then, flush thoroughly with water until all detergent residue has been removed. Repeat this process until the spot is removed.
 - 2) For oil-based spots: After blotting to remove excess liquid, apply a non-water based dry-cleaning solvent* to a towel and apply to the spot. (Applying a dry-cleaning solvent directly to the Carpet surface may allow the spot to spread.) Work from the outer edges of the spot to limit spreading. Continue to reapply solution in this manner until the spot is completely removed. Then flush thoroughly with water until all residue has been removed. In case of permanent stains, repairs may be necessary.*Dry-cleaning solvents denote isopropyl alcohol, denatured alcohol and other, non-water-based cleaning solutions.
 4. Extraction
 - a. In addition to vacuuming and spot removal, extraction will help maintain Carpet’s appearance.
 - b. The procedure for effective soil removal is as follows:
 - 1) Pile lift all heavy soiling areas.
 - 2) Thoroughly vacuum the entire area to remove dry soil.
 - 3) Never use detergent in the extractor rinse tank.
 - 4) Pre-spray the area with an approved pre-spray solution.
 - 5) Use agitation for improved cleaning results.
 - 6) Allow the solution to remain undisturbed for 5 to 10 minutes. This will make the soil easier to remove.
 - 7) Extract the area thoroughly to rinse and remove all the detergent and soil.
 - 8) Repeat until recovery water is relatively clean.
 - 9) Place air movers on the area to expedite the drying time.
 - 10) Limit foot traffic on the area until dry.
 - c. Extraction equipment guidelines:

- 1) Make sure extractor is in proper working order.
 - 2) Disinfect freshwater tank and recovery tank on a weekly basis.
 - 3) Replace nylon brushes at the first sign of wear.
 - 4) Use only original equipment manufacturer parts for consistent performance.
5. Tape Residue Removal
- 1) Following removal of carpet and flooring protective measures, including but not limited to plastic sheeting, adhesive plastic sheeting, Masonite, tape, etc., Contractor is responsible for complete removal of tape residue (per flooring manufacturer recommendations) from flooring surfaces prior to final cleaning.

3.2 SCHEDULE

- A. Traffic Patterns: Identify and evaluate the traffic patterns in the facility and get approval from Owner. Using a floor plan of the facility, color code the plan to identify each of the areas.
- B. Cleaning Schedule:
1. Track-Off Areas: Areas where outside soil is tracked in (entrances, lobbies, restrooms, elevators, and areas next to hard-surface flooring). These areas require specific attention.
 - a. Pre-vacuum prior to spot cleaning
 - b. Spot clean to remove entrenched stains
 - c. Vacuum again using multiple passes
 - d. Pile lift to loosen embedded soil prior to extraction
 - e. Wet extract in each direction using multiple passes to achieve desired appearance level
 - f. Spot clean as necessary
 - g. Vacuum
 2. Heavy Traffic Zones: Areas that experience more than 1,000 foot traffics per day (staging areas, traffic lanes, pivot points and funnel areas)
 - a. Vacuum using multiple passes
 - b. Pile lift to loosen embedded soil prior to extraction
 - c. Wet extract to achieve desired appearance level
 - d. Spot clean as necessary
 - e. Vacuum
 3. Moderate Traffic Zones: Areas that experience 500 to 1,000 foot traffics per day (secondary hallways, administrative areas, offices, and light-use common areas)
 - a. Vacuum using multiple passes
 - b. Pile lift to loosen embedded soil prior to extraction
 - c. Wet extract to achieve desired appearance level
 - d. Spot clean as necessary
 - e. Vacuum
 4. Light Traffic Zones: Areas that experience less than 500-foot traffics per day (conference rooms, areas outside of traffic lanes, and limited use-area)
 - a. Vacuum using multiple passes
 - b. Wet extract as necessary to achieve desired appearance level
 - c. Spot clean as necessary
 - d. Vacuum

5. Areas Prone to Spots and Stains: (break rooms, coffee areas and areas near kitchens)
 - a. Pre-vacuum prior to spot cleaning
 - b. Spot clean to remove undesirable stains
 - c. Pile lift and wet extract as required according to traffic zone identification above
 - d. Spot clean again as necessary
 - e. Vacuum

END OF SECTION

SECTION 01 77 00

GUARANTEES, CERTIFICATES AND CLOSE-OUT

CONDITIONS OF THE CONTRACT, SUPPLEMENTARY CONDITIONS AND DIVISION I APPLY TO THIS SECTION.

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Certain procedures have been developed and are required to fulfill all provisions of the Owner-Contractor Agreement with respect to contract Final Completion and Contract Close-Out for the work/project to be 100% complete.
- B. Refer to AIA Document A201™-2017, General Conditions of the Contract for Construction; as amended and Section CB – Supplementary Conditions of the Contract for Construction; as amended for additional information and requirements.

PART 2 - SUBSTANTIAL COMPLETION

2.1 GENERAL

- A. Projects that involve phase sequential construction of major definable areas of projects that involve separate work on multiple campuses shall have Certificates of Substantial Completion issued for each phase or campus, as applicable and agreed upon by the Owner and Contractor. All conditions for Substantial Completion, including liquidated damages, shall apply for each date of Substantial Completion for each phase or campus, as applicable.
- B. Individual Substantial Completion Dates for each phase or campus shall be determined and agreed upon by the Owner, Architect and Contractor. Where an Alternative Proposal dictating a required, guaranteed completion date (dates) is included in the Proposal Form and accepted by the Owner, the date(s) stated therein shall establish the Substantial Completion Dates to be incorporated into the Agreement.
- C. The following items are a partial list of requirements, as applicable to the Project, which must be completed prior to establishment of a Substantial Completion date. Refer to substantial completion checklist contained within the AIA Document A201™-2017, General Conditions of the Contract for Construction as amended for a complete list.
 - 1. All fire alarm system components must be completed and demonstrated to the Owner.
 - 2. All inspections by government authorities having jurisdiction over the project must have been finalized, any remedial work required by them must have been completed, and Certificates of Occupancy, local fire marshal and health department approval certificates and similar governmental approval forms must have been issued and copies delivered to the Owner and Architect.
 - 3. All exterior clean-up and landscaping must be complete, including required stand of grass mowed, edged, weeded, and fertilized.
 - 4. All interior shall have been completed and cleaned except minor items which, if complete after occupancy, will not, in the Owner's opinion, cause interference to the Owner's use of the building or any portion thereof. Contractor shall provide list of these specific items, which include punch list and completion items. 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 shall be the sole judge of what constitutes a significantly large number of items.
 - 5. All third-party HVAC air and water balancing must be complete.

6. All energy management systems must be complete, fully operational and demonstrated to the Owner, with graphics transferred to the main server.
 7. All emergency/standby generator and low voltage lighting control systems must be complete, fully operational and demonstrated to the Owner.
 8. All security systems must be complete, fully operational and demonstrated to the Owner, and must be monitorable from the District's central Police/Security Center.
 9. All school communications equipment, telephone systems and P.A. systems must be complete and demonstrated to the Owner.
 10. All final lockset cores must be installed and all final Owner directed keying completed.
 11. All room plaques and exterior signage must be complete.
 12. All Owner demonstrations must be completed including kitchen equipment, HVAC equipment, plumbing equipment, and electrical equipment and all life safety systems.
 13. A final certificate of occupancy must be signed by the Contractor and delivered to the Owner.
 14. All operation and maintenance manuals are delivered and approved by Architect and Owner ("D-slant" ring binders in duplicate).
 15. Health Department Inspections and Municipal Utility District (MUD) and Drainage District and County approvals must be provided.
 16. All other reports, testing results, certifications, studies, etc. required by Contract Documents.
- D. Final Cleaning:
1. The work area shall be thoroughly cleaned inside and outside. Cleaning includes removal of smudges, marks, stains, fingerprints, soil, dirt, spots, dust, lint, and other foreign materials from finished and exposed surfaces. Refer to Section 01 71 50 for final clean requirements of remodel areas and carpet.
 2. Remove all temporary facilities.
- E. In order for the project, a major portion thereof, a project phase or project campus 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 them 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, interior and exterior, shall have been completed and cleaned except minor items (Punch List) which, if completed after occupancy, will not, in the Owner's opinion, cause any interference to the Owner's use of the building or any portion thereof.
 3. All items stipulated in 2.1-C above.
- F. The Certificate of Substantial Completion shall be submitted to the Owner and Contractor for their written acceptance of responsibilities assigned to them in such Certificate. Upon such acceptance and consent of surety, if any, the Owner, at his sole discretion, may make (partial) payment of retainage applying to such work or designated portion thereof which is 100% complete and accepted by the Owner. Such payment, if made at all, shall be adjusted in the Owner's favor for work that is incomplete or not in accordance with the requirements of the Contract Documents.
- G. The date of Substantial Completion shall represent day one (1) of the thirty (30) day period to complete all work and correct all deficiencies contained in the Punch List and the ninety (90) day period allowed for complete Contract Close-Out as described below.

2.2 PUNCH LIST

- A. A comprehensive list prepared by the Contractor 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. It is anticipated that the detailed list of items of work to be completed or corrected at the Date of Substantial Completion.
- 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. 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.

2.3 OPERATIONS AND MAINTENANCE MANUALS

- A. Operation and Maintenance (O&M) Manuals shall be delivered prior to, and are a condition of, Substantial Completion to allow the Owner the benefit of having the manuals for on-site training and start-up procedures provided by the Contractor.
- B. Operation and Maintenance (O&M) Manuals shall provide concise descriptions, technical information, principles of operation; operating instructions, maintenance instructions and schedules, MSDS sheets, and other information that will enable the proper on-going operation and maintenance of the material and/or assembly.
- C. Separate O&M Manuals shall be provided for the following as applicable to the project scope of work:

1. Architectural materials, equipment and/or assemblies
 2. Food services materials, equipment and/or assemblies
 3. Mechanical materials, equipment and/or assemblies
 4. Plumbing materials, equipment and/or assemblies
 5. Electrical materials, equipment and/or assemblies
 6. Low-voltage systems materials, equipment and/or assemblies
 7. Theater lighting/sound systems materials, equipment and/or assemblies
- D. Provide O&M Manuals/information for all materials, equipment and/or assemblies where required in individual sections of specifications.
- E. Each O&M Manual shall contain a cover and spine label depicting contents as delineated in paragraph C above; and within each Manual shall be organized in numerical order corresponding to specification sections.
- F. O&M Manuals shall be provided in 3-ring binders similar to close-out manuals described above.
1. O&M manuals shall contain a table of contents listing the specification number with corresponding general description of the material, equipment, and/or assembly included in the manual.
 2. The indexed sections shall be divided and identified by tabbing each section as listed in the index.
- G. Deliverables:
1. Provide electronic copy of all O&M manuals for review. Deliver A/E Consultant O&M Manuals directly to the relative A/E Consultant with a copy of the transmittal to the Architect.
 2. Resubmit as necessary to obtain final acceptance of Manuals.
 3. Once all corrections have been made and the O&M Manuals found to be acceptable, provide one (1) hard copy of each binder and one (1) PDF format electronic copy of each binder to the Architect for transfer to the Owner.

2.4 SUBSTANTIAL COMPLETION SCHEDULE

- A. After the date of Substantial Completion of the project as evidenced by the Certificate of Substantial Completion, AIA document G704-2000, the Contractor will be allowed a period of thirty (30) days, unless extended by mutual agreement or provision of the Contract, within which to complete all work and correct all deficiencies contained in the Punch List attached to the Certificate of Substantial Completion. It is incumbent upon the Contractor to request Substantial Completion **only** when there is assurance that all work included on the Punch List shall be completed within the thirty (30) day time frame.
1. In the event the Owner must take occupancy of the project prior to Contractor's completion of the punch list, the Contractor shall make all adjustments necessary to schedule the work to allow full and normal operation of the project by the Owner.
 2. Where this requires work outside of normal business hours, the work shall be provided at no additional cost to the Owner.
- B. Upon Contractor's and sub-contractor's verification that all punch list items have been 100% completed, the Contractor shall notify the Architect and the Architect and consultant(s) shall conduct an on-site observation to verify that all items are 100% complete.
1. On-site verifications for partial completions, if any, shall be conducted by the Architect at the Architect's discretion.
 2. If any items shown to be complete by the Contractor are found not to be complete by the Architect, the observation shall be stopped, with such notification to the Contractor.
 3. Contractor's requested punch list observations by the Architect shall be limited to a maximum of two (2) per punch list.

- C. If the Contractor fails to complete all work on the punch list within thirty (30) days after the Substantial Completion date, Contractor shall be required to attend weekly meetings at the project site or Owner's office until such time as 100% of the punch list items are completed and accepted by the Owner. During this time the Contractor will be charged from the Owner's, Architect's and any A/E Consultant's time associated with achieving completion of the punch list.
1. Billable time shall include, without limitation, travel time, meeting time, document preparation, document review, and re-inspection of on-site conditions.
 2. The weekly meetings shall include a minimum of two (2) hours charge per participant.
- D. Owner billable time shall be deducted from the Contractor's Final Payment or separately invoiced to the Contractor at Owner's option. Owner billable hourly rates shall be as follows:
1. Assistant Superintendent: \$200.00 per hour
 2. Director: \$175.00 per hour
 3. Project Manager: \$150.00 per hour
 4. Project Coordinator: \$120.00 per hour
 5. Administration/Secretarial: \$50.00 per hour
- E. Architect and A/E Consultant billable time shall be invoiced to the Contractor by the Architect. A/E billable rates shall be as follows:
1. A/E Principal: \$175.00 per hour
 2. A/E Project Manager: \$150.00 per hour
 3. Staff Architect/Consultant: \$120.00 per hour
 4. A/E Field Representative: \$100.00 per hour
 5. Administration/Secretarial: \$50.00 per hour

PART 3- PRODUCTS

- 3.1 Not used.

PART 4 - CONTRACT CLOSE-OUT

4.1 GENERAL

- A. Upon issuance of the (final) Certificate of Substantial Completion, and per the Owner- Contractor Agreement, the Contractor will be allowed a period of ninety (90) days within which to complete all Contract Close-Out requirements, unless extended by mutual agreement or provision of the Contract.
- B. In addition to all work and requirements described for Substantial Completion, in order to achieve Contract Close-Out, the Contractor shall submit all Close-Out documents per Form AO.

Record Document

- C. Final/ 100% release of retainage will not be authorized by the Architect until the Contractor completes all of the requirements for Contract Close-out; and until all expenses incurred and to be paid by the Contractor have been paid in full.
- D. It is the Contractor's sole responsibility prior to submission to verify that Close-Out documents being submitted for review and acceptance are 100% complete and accurate. The Owner/Architect reserves the right to reject any incomplete close-out documents.
1. Upon discovery by the Architect that Close-Out documents are incomplete and/or inaccurate, the Architect's review shall cease, and the Contractor shall be so notified.

2. The A/E Consultants' will provide a comprehensive list of possible missing and/or incorrect items needed.
- E. It is desirable and beneficial to submit all Close-Out documents as a single submission; however, Close-Out documents may be submitted separately in four (4) deliverables as follows:
1. Close-Out Documents Manual
 2. Operations and Maintenance Manuals (required prior to Substantial Completion)
 3. Record Drawings
 4. Owner's Record Copy of Submittals (one (1) flash drive in PDF format)
- F. Close Out Tracking
1. Contractor shall track the progress of project closeout utilizing excel spreadsheets which will be provided by the Architect (see examples attached at the end of this Spec Section).
 2. Contractor shall update closeout tracking spreadsheets weekly and submit electronic copy to Architect twenty-four hours prior to the weekly closeout review meetings.
 3. Master Closeout Checklist represents all items required to be provided by the Contractor to the Owner at the conclusion of the project. It is more general in nature and only includes a status of the closeout item in question. It does not drill down into the details of when the item was submitted, why it was rejected, when it was approved, etc. This checklist will be used throughout the project to track all closeout deliverables.
 4. Detailed Checklists are more comprehensive lists developed for each section of the closeout requirements. These lists are used by the Contractor to identify and track every deliverable required from each subcontractor. This list will contain a separate entry for each item that is required from each and every subcontractor. It should include the specification section that lists the requirement, a description of the item, responsible subcontractor, and the dates that the items were requested, received, and transmitted to the Owner. The information included in these detailed checklists is used to update the Master Closeout Checklist.
 5. A sample of the Master and Detailed Checklists are attached at the end of this Spec Section. An excel file with the checklists will be provided by Architect.

4.2 CLOSE-OUT MANUALS FORMAT

- A. All close-out documents shall be submitted in CFISD provided digital format with detailed table of contents, intext tabs corresponding to the table of contents.
1. The close-out documents must be neatly organized and easily useable, as determined by the Architect and Owner.
 2. At completion and final review, submit one (1) electronic PDF file and one (1) flash drive containing close-outs.

Table of Contents

Part 1: Close-Out Log

- a. Project Checklist – Form AO
- b. Close Out Log

Part 2: Project Directory

- a. Project Team (architect, engineer, contractor, consultants)
- b. List of Final Subcontractors/Suppliers/Local Representatives (by Specification Section)

Part 3: Close-out Documents and Affidavits

- a. AIA G707 - Consent of Surety to Final Payment
- b. AIA G706 - Contractor's Affidavit of Payment of Debts and Claims
- c. AIA G706A - Contractor's Affidavit of Release of Liens
- d. Subcontractor's Release of Lien

Part 4: Project Documents and Certificates

- a. AIA G704 - Certificate of Substantial Completion
- b. Punch List / Architects Letter Confirming Completed Punch List
- c. Copy of All Permits
- d. Copy of Final Utility Bill or Letter of Transfer
- e. Certificate of Occupancy
- f. Certification of Project Compliance
- g. Hazardous Material Certificate
- h. Asbestos Manifest / TDLR Inspection / EAB Letter / Structural Letter / Material Testing Letter(s) / Commissioning / other Consultants
- i. Form AQ - Certificate of Final Completion

Part 5: Warranties (Compiled Sequentially by Specification)

- a. General Contractor's Warranty
- b. Subcontractor's Warranty
- c. Extended Warranties & Maintenance / Service Agreements

Part 6: Insurance (General Contractor / Subcontractor)

- a. Continued Coverage
- b. Worker's Compensation Certificate

Part 7: Receipts

- a. Extra Stock by Division
- b. Keys
- c. Paint Mix Cards

Part 8: Record Documents

- a. Demonstration and Training Sign-in Sheets by Division with Digital Video
- b. Operations & Maintenance Manuals and Record Drawing Transmittal(s)

4.3 WARRANTIES

- A. All guarantees and warranties required by the Contract Documents shall establish the date of Substantial Completion as day one (1) of the required warranty period; regardless of how long the product, assembly or work has been installed or in operation prior to Substantial Completion.

1. Coordinate with subcontractors and material suppliers to account for provision in their original proposal/bid amount, if necessary.
- B. Contractor's One-Year Warranty: The Contract requires the General Contractor to warrant ALL materials and work provided/furnished for a period of one (1) year following the date of Substantial Completion.
 1. The one-year general warranty shall include all labor, material and delivery costs required to correct defective material or installation during the Warranty period.
- C. Sub-Contractor's One-Year Warranty: each sub-contractor that performed work on the project shall be required to submit a one-year warranty similar to the above Contractor's One-Year Warranty for their specific work provided.
- D. Extended Warranties: In addition to the General Contractors and subcontractors' one-year warranty, other required guarantees shall be included in the Close-Out Binder in original issue form. All extended warranties shall begin on the Substantial Completion date; and shall include all labor, material and delivery costs required to correct defective material or installation for the entire required extended warranty period, as specified in the respective specification section.

4.4 RECORD DRAWINGS:

- A. Upon Substantial Completion, the Contractor shall be furnished, at no charge, a complete set of electronic files in AutoCAD release 2018 or later, and Revit if applicable, of all drawings included in the Contract Documents. The title blocks shall be stripped of all logos, disclaimers and licensed seals of the Architect and Consultants.
 1. Applicable CTB or plot files shall be furnished by the Architect and each Consultant.
 2. Throughout the construction phase, Architect's and Consultant's supplemental drawings/sketches provided to the Contractor in AutoCAD and Revit format shall be provided to the Contractor electronically and shall be incorporated in the electronic files by the Contractor.
- B. Upon request, the Architect and/or Consultants shall assist the Contractor with understanding the structure and composition of the electronic files to facilitate the generation of the Record Drawings.
- C. The Contractor shall modify the title block on each/every sheet to include only the project name, project address, Owner name, consultants' name and address, date, and clearly identify the set as "Record Drawings".
- D. All electronic Record Drawing work shall be performed in a professional manner using AutoCAD and Revit, as applicable, and shall maintain the format/structure/composition of the original Contract Document drawings.
- E. All modifications, additions, deletions, and revisions made to the project during the construction phase shall be reflected on the Record Drawings; and shall include, but not necessarily limited to:
 1. All as-built dimensions (different than original dimensions)
 2. All as-built locations and conditions relative to underground plumbing, sanitary and storm piping installations, natural gas piping and electrical conduits; shown accurately to within twelve (12) inches. Notes shall indicate approximate depth of all underground piping and utilities.
 3. All as-built conditions relative to ductwork installations; shown accurately to within six (6) inches.
 4. All as-built conditions relative to HVAC water piping installations; shown accurately to within six (6) inches.
 5. All as-built conditions relative to underground electrical conduit installations. shown accurately to within six (6) inches.
 6. Record drawings shall include a copy of fire sprinkler layout of piping and equipment.

7. All approved CPR's resulting in a physical change in the work.
 8. All RFI's resulting in a physical change in the work.
 9. All AEA's resulting in a physical change in the work.
 10. All Minor Changes resulting in a physical change in the work.
 11. All Construction Change Directives resulting in a physical change in the work.
 12. Update the list of drawings as necessary to reflect added and deleted sheets.
- F. All modifications shall be represented by actually deleting the original work and accurately depicting the revised as-built modifications/configurations. "X-ing out" deleted work shall not be accepted.
- G. Upon completion of all revisions to the Record Drawings, including the Architect's acceptance, the Record Drawings shall be copied to a thumb drive or solid-state media drive maintaining the exact folder/file structure originally furnished to the Contractor. Submit to the Architect for review before proceeding with deliverables.
- H. Deliverables: Upon Deliverables: review and acceptance of the documentation, including format, the Architect shall direct the Contractor to proceed with delivery of the following:
1. Three (3) thumb drives or solid-state media drives, containing the entire set of Record Drawings in PDF and TIFF format. Each sheet shall be a separate PDF and TIFF file. The thumb drives shall be organized to duplicate the order of drawings as they were issued for bidding and construction, with record drawing modifications.
 2. Three (3) thumb drives or solid-state media drives, containing the entire set of Record Drawings in AutoCAD and Revit format as applicable. Each sheet shall be a separate AutoCAD or Revit file. The thumb drives shall be organized to duplicate the order of drawings as they were issued for bidding and construction, with record drawing modifications.

4.5 RECORD SUBMITTALS

- A. The Contractor shall maintain and submit a separate set of final submittals to be delivered to the Owner as a condition of Contract Close-Out.
- B. Include only the final version of each submittal, including all submittal review comment sheets from the Architect and Consultant. Versions of submittals that were rejected or required to be revised and resubmitted are not required.
- C. Deliverables:
1. Deliver one (1) hard copy set of Record Submittals in file boxes, organized in order by specification division, with tabs included for each section of specifications and submittal log of contents of each file box.
 2. Deliver three (3) copies of all Record Submittals in PDF electronic format on three (3) thumb drives or solid-state media drives.

4.6 RECORD SPECIFICATIONS/PROJECT MANUAL

- A. The Contractor shall submit a record copy of specifications in hard copy and also in Microsoft Word electronic format on thumb drive or solid-state media drive. Record specifications shall be edited to contain only actual manufacturers, products, colors and model numbers actually used in the project.

4.7 CONTRACT CLOSE-OUT SCHEDULE

- A. If the Contractor fails to complete requirements of Contract Close-Out within sixty (60) days after the actual Substantial Completion date, Contractor shall be required to attend weekly meetings at the project site or Owner's office until such time as 100% of the Close-Out documents are completed and accepted by the Owner. During this time the Contractor will be charged for the Owner's, Architect's and any A/E Consultant's time associated with achieving Final Completion.

1. Billable time shall include, without limitation, travel time, meeting time, document preparation, document review, and re-inspection of on-site conditions.
 2. The weekly meetings shall include a minimum of two (2) hours charge per participant.
 3. Refer to A201 – for Owner and Architect/A&E/Consultants billable times.
- B. In scheduling submission(s) and final approvals of Close-Out documents, the Contractor shall allow for the following review period for each submission:
1. Architect: Ten (10) calendar days
 2. Architect's Consultant: Twelve (12) calendar days.
- C. Additionally, failure by the Contractor to complete Contract Close-Out within the stipulated time will be reported to the Contractor's surety. In the report of deficiency, the Contractor and surety will be informed that, should correction work remain incomplete for fifteen (15) additional days, the Owner at his discretion may initiate action to complete corrective work out of the remaining contract funds in accordance with the Owner-Contractor Agreement, General and Supplementary Conditions to the Agreement as they apply.
1. Additional costs of the Owner, Architect, and other consultants incurred because of the Contractor's failure to complete Contract Close-Out within sixty (60) days after the date of Substantial Completion, unless extended by mutual agreement or provision of the contract, will be deducted from the funds remaining to be paid to the Contractor.

4.8 WARRANTY INSPECTION

- A. Approximately six months after substantial completion and at one (1) month prior to expiration of the one-year guarantee period, the Contractor shall notify the Architect and Owner to schedule 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 warranty 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 though the date of completion of the corrective work may extend beyond the expiration date of the guarantee 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.

END OF SECTION

SECTION 01 87 16 – MOVE MANAGEMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Relocate and store offsite at secure area all movable items including:
 - 1. Boxes of classroom and storage room items.
 - 2. Shelves.
 - 3. Appliances (microwaves and refrigerators) – located in teacher’s lounge, nurse’s office, CTE classrooms and life skills.
 - 4. Gym racks and supplies.
 - 5. Athletic Equipment
 - 6. Press Box equipment

- B. Contractor will remove all movable furniture at Cy Ridge High School and dispose of this furniture in it’s entirety.
 - 1. This movable furniture includes all desks, chairs, tables, etc.. The Owner has the right of identifying any furniture to be salvaged prior to removal.
 - 2. Disposal of this furniture includes, but is not limited to removing furniture out of the building to dumpsters on site and disposing of the furniture dumpsters at a location to be determined by the Contractor. (Number of dumpsters required for this scope of work to be determined by the contractor)
 - 3. Dispose of all movable furniture in the press boxes as well.

- C. Relocate and store offsite at secure and conditioned area the following:
 - 1. Box items from clinic.
 - 2. Boxed library books
 - 3. Technology equipment, promethean boards, computers, printers.

- D. Provide the following number of moving supplies in the base proposal for Cy Ridge High School:
 - 1. 2,000 interlocking boxes
 - 2. 12 cases of tape
 - 3. 20 tape dispenser guns
 - 4. 1000 medium bags
 - 5. 200 monitor bags
 - 6. 5,000 labels, (1000 labels in 5 separate colors)
 - 7. 200 gondola boxes.

1.2 DELIVERY, STORAGE, AND HANDLING

- A. Store products in secure conditioned and unconditioned warehouse as noted.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Provide move management meeting with CFISD and all interested parties at least one month prior to the end of school
- B. CFISD reserves the right to review and approve the storage site(s) prior to moving.

3.2 PREPARATION

- A. Supply boxes for moving/storage including tape and labels.
- B. Contractor to assist librarian in boxing of library boxes within one month prior to the last day school, June 1, 2025.
- C. Contractor to remove all items from site beginning June 1, 2025 after school ends.

3.3 INSTALLATION

- A. Contractor shall return removed and restored items to their location from where they were removed.
- B. Assist librarian with unboxing the boxed library books.
- C. All other boxes will be unboxed by others.
- D. Contractor to move all items to site by August 14, 2026 before school begins.

3.4 PROTECTION

- A. Contractor to verify existing condition of items to be relocated and returned in same condition.
- B. Clean building and site after product moves.
- C. Protect stored products until completion of project.
- D. Touch-up, repair or replace damaged building and site before Substantial Completion.

3.5 EXCLUDE THE FOLLOWING:

- A. CFISD to box classroom items and storage room items.
- B. Operations/Custodial supplies (i.e., paper goods, mops, buckets, soap)
- C. Health service equipment (i.e., life skills special needs equipment)
- D. Basketball equipment in gymnasium.
- E. Cafeteria tables.
- F. Kitchen equipment.
- G. Unboxing of items.

END OF SECTION

SECTION 01 91 00

GENERAL COMMISSIONING REQUIREMENTS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Specifications throughout all Divisions of the Project Manual, which pertain to operable and non-operable equipment and/or building systems, are directly applicable to this Section, and this Section is directly applicable to them.

1.2 SUMMARY

- A. This Section establishes general and administrative requirements pertaining to commissioning of equipment, devices, and building systems on the project. Technical requirements for commissioning of particular systems and components are established in the respective technical sections of this Project Manual.
- B. It is of primary concern that all operable systems installed in the Project perform in accordance with the Contract Documents, the Owner's Project Requirements (OPR) and the Basis of Design (BOD). During Commissioning, the Contractor systematically demonstrates to the Owner or Owner's representative that the operable systems have been installed and performing in strict accordance with the Contract Documents.
- C. Commissioning requires cooperation and involvement of all parties throughout the construction process. The Contractor shall deliver a successful Commissioning process. Successful Commissioning requires that installation of all building systems complies with Contract Document requirements and that full operational check-out and necessary adjustments are performed prior to Substantial Completion with the exception of Deferred tests approved in advance by the Owner.
- D. Commissioning will encompass and coordinate traditionally separate functions of system documentation, installation checkout, System Verification Checklists and start-up, control system calibration and point-to-point checkout, testing, adjusting, and balancing, Functional Performance Tests, Integrated System Tests, Contractor demonstration to the Owner, and training of Owner's personnel. This requires assembling all related documentation into one cohesive collection. Commissioning is intended to achieve the following specific objectives of the Contract Documents:
- E. Verify and document proper installation and intended performance of equipment, systems, and integrated systems.
- F. Ensure that operating and maintenance and Commissioning documentation requirements are complete.
- G. Provide the Owner with functional buildings and systems that meet the Contract Document requirements and the Owner's Project Requirements (OPR) at Substantial Completion.

1.3 DEFINITIONS

- A. Basis of Design (BOD): A document that records the concepts, calculations, decisions, and product selections used to meet the Owner's Project Requirements and to satisfy applicable regulatory requirements, standards and guidelines. The document includes both narrative descriptions and lists of individual items that support the design process.
- B. Commissioning (Cx): A systematic process confirming that building systems have been installed, properly started, and consistently operated in strict accordance with the Project Documents, that all systems are complete and functioning in accordance with the Contract Documents at Substantial Completion, and the Contractor has provided the Owner adequate system documentation and training.

- C. Commissioning Authority (CxA): Party having a contractual agreement with the Owner to provide third party commissioning services as defined herein under Commissioning Authority's Role and Responsibilities. Commissioning Authority may represent the Owner and is authorized to act on behalf of the Owner. The Commissioning Authority does not have authority to alter design or installation procedures without the written approval of the Owner or the design team.
- D. Contract Documents: The General Conditions, Drawings, Specifications, Addenda, and other documents developed by the A/E Team and approved by the Owner that constitute the contractual obligations of the project scope.
- E. Control Point and Sensor Calibration Verification: Process of verifying the point integrity and/or sensor calibration from the physical point of monitoring (sensor, contact, actuator, etc.) to the digital point location at the Operator's interface within the respective control system (Building Automation, Lighting Controls, Power Status and Monitoring, etc.).
- F. Deferred Testing: Functional Performance or Integrated System Tests performed after Substantial Completion due to partial occupancy, partial equipment acceptance, seasonal requirements, design, or other site conditions that prohibit the test from being performed prior to Substantial Completion.
- G. Deficiency: Condition of a component, piece of equipment, or system that is not in compliance with the Project Documents.
- H. Functional Performance Test (FPT): Test of dynamic function and operation of equipment and systems executed by the Contractor and witnessed by the CxA. Systems are tested under various modes, such as during low cooling or heating loads, high loads, component failures, unoccupied, varying outside air temperatures, life safety conditions, power failure, etc. Systems are operated through all specified sequences of operation. Components are verified to be responding in accordance with requirements in the Project Documents.
- I. Functional Performance Testing Procedures: Commissioning protocols, detailed test procedures and instructions in tabular and script-type format that fully describe system configuration and steps required to determine if the system is performing and functioning properly.
- J. Integrated Systems Test (IST): Test of dynamic function and operation of multiple systems. Integrated Systems Tests are tested under various modes, such as fire alarm and emergency situations, life safety conditions, power failure, etc. Systems are integrally operated through all specified sequences of operation. Systems and interconnections are verified to be responding in accordance with the requirements in the Project Documents.
- K. Integrated Systems Testing Procedures: Commissioning protocols and detailed test procedures and instructions in tabular and script-type format that fully describe system configurations and steps required to determine if the interacting systems are performing and functioning properly.
- L. Operational Testing: Activities and testing occurring after initial energizing and/or start-up of equipment that determine whether equipment is operating within the manufacturer's recommendations and the design requirements. These activities are intended to ensure that equipment and systems meet all warranty requirements and are ready for Functional Performance Testing. Common examples are Testing, Adjusting and Balancing of HVAC systems and initial load testing of electrical equipment.
- M. Owner's Project Requirements (OPR): A written document that details the functional requirements of a project and the expectations of how the facility will be used and operated. These include project goals, measurable performance criteria, cost considerations, benchmarks, success criteria and supporting information.
- N. Project Documents: Consists of the Contract Documents, Approved Submittals, Requests for Information (RFI), Vendor documentation, Operations and Maintenance (O&M) information and other

documentation that determines the requirements for acceptable installation and operation of the specific equipment and systems on the project.

- O. System Verification Checklist (SVC): A list of static inspections and material or component tests that verify proper installation of equipment (e.g., belt tension, oil levels, labels affixed, gages in place, sensors calibrated, etc.), start-up activities and documentation, as well as operational testing results. The checklists are meant to document all activities for an individual piece of equipment from procurement on the project through operational testing are performed in accordance with the requirements in the project documents.
- P. Start-up: The activities where equipment is initially energized, tested and operated. Start-up is completed prior to Operational Testing and Functional Performance Testing and is an integral item documented in the System Verification Checklist (SVC).
- Q. Training Plan: A detailed plan prepared by the Contractor and reviewed by the Owner and Commissioning Authority that outlines the training activities, instructors, time durations, and system requirements in accordance with the Contract Documents and Commissioning Plan.
- R. Trending: Data collection of monitored points using the Building Automation System, Lighting Controls System, Power Status and Monitoring System or independent data acquisition instrumentation.

1.4 COMMISSIONING TEAM

- A. Owner shall appoint the following Members:
 - 1) Owner's Project Manager and any other designated representatives of the Owner's staff.
 - 2) Commissioning Authority (CxA)
 - 3) Architect/Engineer (A/E)
 - 4) Test, Adjust and Balance Firm (TAB) – may be sub-contracted to the CxA
- B. Contractor shall appoint the following Members:
 - 1) Individuals, each having authority to act on behalf of the entity they represent, explicitly organized to implement the Commissioning process through coordinated actions. At a minimum, the Contractor shall designate a Commissioning Coordinator and each major sub-contractor (Mechanical, Electrical, Plumbing, Building Automation) shall have a dedicated representative.
 - 2) Vendor representatives (as needed) required for start-up, operational testing, Functional Performance Testing, Integrated Systems Testing, and Owner Training activities.
 - 3) Representatives of independent testing agencies (Test, Adjust and Balance, Electrical Testing Agency, etc.)

1.5 ROLES AND RESPONSIBILITIES

- A. Roles and responsibilities of Commissioning Team members related to the Commissioning Process are provided in this Section. The respective entities defined below shall fulfill the listed roles and responsibilities as contained herein. Specific technical roles and responsibilities are defined in other sections of the Project Specifications.
- B. Owner's Roles and Responsibilities:

- 1) Provide guidance in development of the Owner's Project Requirements (OPR).
 - 2) Review Technical Specifications containing Commissioning requirements.
 - 3) Approve the Commissioning Scope of Work and schedule of Commissioning activities.
 - 4) Assign Owner's representatives and schedule them to participate in Commissioning activities, including the following:
 - a. Commissioning Team meetings.
 - b. Review and approval of the Commissioning Plan, Training Plan, System Verification Checklist templates, Functional Performance Test Procedures, Integrated Systems Test Procedures, Deferred Testing Plans, Final Commissioning Process Report, Systems Manual, Measurement and Verification Plan and other Commissioning documents.
 - c. Attend Owner Training sessions in operation and maintenance of systems and equipment.
 - d. Observation of Contractor's demonstration of systems and equipment operation.
- C. Commissioning Authority's (CxA) Roles and Responsibilities:
- 1) Prepare the Commissioning Plan with the Owner's and Contractor's review and input.
 - 2) Periodically attend and/or review the proceedings of the regular Construction Meetings hosted by the Contractor to understand the progress of construction activities on the project.
 - 3) Conduct and document Commissioning Team meetings including the Commissioning Kickoff Meeting.
 - 4) Perform site visits as necessary to observe component and system installations prior to energizing or start-up of equipment and systems.
 - 5) Review and comment on product data and shop drawing submittals and coordination drawings applicable to systems being commissioned.
 - 6) Following submittal review and approvals by the A/E team, review the sequences of operation and coordinate with the Contractor and A/E Team in order to prepare the Functional Performance Test Procedures and Integrated Systems Test procedures. Submit to the Owner and Contractor for review and comment prior to facilitating FPTs and ISTs on the project.
 - 7) Upon written notice that equipment or systems are ready for initial energizing or start-up, review the progress of the System Verification Checklist(s) for the respective systems and components and ensure that all requirements have been completed by the Contractor to permit energizing or start-up in accordance with the project documents; CxA shall issue written notice to the Owner and Contractor that equipment is ready to energize or start-up. CxA will witness and ensure proper documentation is provided by the Contractor for major equipment energizing and start-ups as executed by the Contractor with appropriate notice as indicated herein.
 - 8) Witness, verify, and document results of Functional Performance Tests and Integrated Systems Tests.
 - 9) Coordinate resolution of deficiencies identified during site observations, equipment energizing or start-up, Functional Performance Testing, Integrated Systems Testing, Deferred Testing, and during the warranty period.

- 10) Review the Operating and Maintenance (O&M) documents to ensure that as-built information and correct data is included prior to the Owner Training sessions; review final O&M submittal to ensure compliance with the requirements in the project documents and provide written comments to the Owner.
- 11) Review the Contractor's Training Plan and individual training agendas for compliance with the requirements in the project documents. Recommend acceptance to the Owner prior to the Contractor scheduling training sessions with the Owner. Review the attendance and content of the training sessions to ensure the requirements of the project documents are completed. Conduct a survey of the Owner's personnel to evaluate the effectiveness of the Owner Training.
- 12) Compile the Final Commissioning Process Report and submit to the Owner for review and approval.

D. Architect/Engineer's (A/E) Roles and Responsibilities:

- 1) Specify control sequences of operation within the Contract Documents that comply with the OPR and BOD.
- 2) Incorporate Commissioning requirements into the Contract Documents if requested by the Owner.
- 3) Attend Commissioning Team meetings.
- 4) Review the Commissioning Plan, System Verification Checklist templates, Functional Performance Test Procedures, Integrated Systems Test Procedures, Deferred Testing Plans, and other Commissioning documents as required by the Owner or the Contract Documents.
- 5) Review Contractor's Training Plan and provide comments to the Owner.
- 6) Approve technical requirements for correction of Deficiencies identified during Commissioning, Deferred Tests, and during the warranty period.
- 7) Review Operating and Maintenance Manuals and provide comments to the Owner.

E. Contractor's Roles and Responsibilities:

- 1) Contractor shall review and provide comments on documents produced by the Commissioning Authority, and shall accept the Commissioning Plan, System Verification Checklists, Functional Performance Test Procedures, and Integrated System Test Procedures as approved by the Owner.
- 2) Provide an individual, subject to the Owner's approval, experienced in construction and Commissioning of building systems to organize, schedule, conduct, and document the Contractor's responsibilities in the Commissioning process. The Contractor shall assign this individual to act as the Contractor's Commissioning Coordinator. The Contractor's Commissioning Coordinator may have additional duties such as MEP Coordinator, but not as Project Manager or Superintendent. Submit qualifications demonstrating the Commissioning Coordinator's technical expertise and experience to the Owner for approval. In the event that Contractor chooses to subcontract its Commissioning obligations, then Contractor must submit the subcontractor's qualifications and personnel to Owner for Owner's approval.
- 3) Furnish and install systems that meet all requirements of the Contract Documents.
- 4) Ensure that Commissioning Process activities are incorporated into the Master Project Schedule. The Contractor shall coordinate with the CxA and the Owner to determine the required activities, durations and predecessors.
- 5) Submit inspection requests, start-up requests and all supporting documentation in accordance with

the Contract Documents, General Conditions, and Commissioning Plan.

- 6) Cooperate with Owner's representative(s), provide access to work and provide adequate labor, resources, and time for Commissioning.
- 7) Furnish copies of all shop drawings and submittals, manufacturers' literature, maintenance information, and any other information required for the Commissioning process. Contractor must submit to the Owner installation and checkout materials actually shipped inside equipment and actual field checkout sheet forms used by the factory or field technicians. This requirement does not supersede any additional requirements contained in the Contract Documents.
- 8) Schedule and conduct pre-installation meetings and pre-commissioning meetings with subcontractors and equipment suppliers related to Commissioning. Contractor must invite Architect/Engineer, Owner and CxA to attend the pre-installation meetings and pre-commissioning meetings.
- 9) Provide qualified personnel, including subcontractors as required, to fully perform the testing and operational demonstrations required by the Contract Documents and the Commissioning Plan, including any Deferred Testing or re-testing related to warranty work.
- 10) Correct deficiencies identified during any stage of the Commissioning process.
- 11) Coordinate with the CxA to develop the Training Plan and submit to the Owner for approval. Provide training to the Owner's personnel in accordance with the Contract Documents and the approved Training Plan. Coordinate with the Owner to schedule training sessions and coordinate subcontractor/vendor participation in all training sessions.
- 12) Perform Deferred Testing and make necessary amendments to Operating and Maintenance Manuals and as-built drawings for applicable issues identified during the Deferred Testing.
- 13) Perform system maintenance during construction as specified and recommended by the Owner and send the maintenance records to the Owner for Record.
- 14) Document the equipment as it arrives onsite to ensure that the submitted and received equipment is correct as it arrives onsite, including the completion of the system verification sections pertaining to the procurement process.

1.6. SYSTEMS TO BE COMMISSIONED

1.6.1. The following systems shall be commissioned according to the process defined in this Section:

1.6.1.1. Major HVAC Systems (100% including but not limited to the list below)

- 1.6.1.1.1 Air Handling Units
- 1.6.1.1.2 Fan Coil Units
- 1.6.1.1.3 Exhaust Fans
- 1.6.1.1.4 Supply Fans
- 1.6.1.1.5 Pumps
- 1.6.1.1.6 Chillers
- 1.6.1.1.7 Boilers

1.6.1.2. Terminal Units (10% Sampling)

1.6.1.3. Building Automation System

1.6.1.4. Lighting Controls - Occupancy Sensors (25% greater than 25 sensors installed, 100% less than 25 sensors installed)

- 1.6.1.5. Lighting - Daylight Controls (100%)
- 1.6.1.6. Lighting - Time Switch Controls (100%)
- 1.6.1.7. Normal and Emergency Power Systems

PART 2 - PRODUCTS

2.1. COMMISSIONING PLAN

- 2.1.1. Document developed by the CxA that provides the structure, schedule, and coordination plan for the Commissioning Process from the Pre-construction phase through the Occupancy Phase. The Commissioning Plan shall describe the project and systems to be commissioned, Commissioning Process activities and deliverables, procedures to follow throughout the process, specific roles and responsibilities for each participant, and general description of testing and verification methods.
- 2.1.2. The Commissioning Plan shall comply with the Owner's Project Requirements (OPR).
- 2.1.3. The Commissioning Team shall review the Commissioning Plan prior to the Pre-Commissioning Meeting and submit written comments or questions to the CxA to be addressed in the meeting.
- 2.1.4. Following the Pre-Commissioning meeting, the CxA shall incorporate all changes discussed and agreed upon in the Pre-Commissioning meeting and submit the Final Commissioning Plan to the Commissioning Team for approval and acceptance.
- 2.1.5. If changes to the Commissioning Plan are needed during the Commissioning Process, the CxA shall edit the plan and distribute to the Commissioning Team for approval and acceptance.
- 2.1.6. The Contractor's acceptance shall constitute acceptance of all parties sub-contracted to the Contractor. The Contractor shall ensure that all sub-contractors and vendors agree and accept the Commissioning Plan.

2.2. SYSTEM VERIFICATION CHECKLISTS

- 2.2.1. System Verification Checklists (SVCs) are important to ensure that the equipment and systems are connected and operational and that Functional Performance Testing proceeds without unnecessary delays. These checklists document the inspections and procedures necessary to take a piece of equipment from a static state into an operating state. These checklists augment the manufacturer's start-up checklists to provide a complete document from procurement to the start of Functional Performance Testing when combined.
- 2.2.2. The CxA shall develop the System Verification Checklist templates for review by the Cx Team. The Contractor, appropriate Subcontractors and Vendors shall support the CxA in development of SVCs for each system and components by providing any necessary supporting documentation as requested by the CxA and reviewing and commenting on the checklist templates in accordance with the Project Specifications and the Commissioning Plan.
- 2.2.3. Once the checklist templates are reviewed and accepted, the CxA will produce checklists for all equipment and components to be commissioned on the project utilizing an electronic commissioning database that is accessible via web portal or local field tool (i.e., iPad, tablet, laptop, etc.).
- 2.2.4. The CxA shall provide login access and training to the Contractor and other members of the Cx Team in the use of the electronic commissioning database.
- 2.2.5. The Contractor shall be responsible for completing the required sections of the System Verification

Checklists utilizing the electronic commissioning database and providing all supporting documentation via electronic transmittal to the CxA. Additional requirements for completion of the SVCs are included in this section and other technical sections of the Specifications.

- 2.2.6. Once equipment arrives on the project site, the Contractor or sub-contractors shall begin completing the individual checklists and continue throughout the installation process. The checklists are meant to be progressive and a tool for tracking progress.
- 2.2.7. Once the SVCs are electronically completed, the CxA will review and approve the checklists and supporting documentation and compile the information to include in the Final Commissioning Process Report.

2.3. FUNCTIONAL PERFORMANCE TESTING PROCEDURES:

- 2.3.1. The purpose of the Functional Performance Testing Procedures is to verify and document that the equipment and systems on the project individually perform in accordance with the requirements in the Contract Documents and meet the Owner's Project Requirements.
- 2.3.2. The CxA shall develop specific script-type test procedures to verify and document proper operation of each piece of equipment and system. The Contractor shall provide any supporting information to the CxA that may be needed including but not limited to product submittals, O&M information, and sequences of operation. Once developed, the CxA will issue to the Cx Team for review and comment.
- 2.3.3. The Commissioning Team shall review the Functional Performance Test procedures and submit written comments or questions to the CxA. The Contractor shall ensure that the sub-contractors and any vendors that would be involved with Functional Performance Testing review the procedures and provide comments.
- 2.3.4. The CxA will coordinate with the Cx Team to address any comments and produce the final FPT procedures for acceptance by the Cx Team. The Contractor's acceptance shall constitute acceptance of all parties sub-contracted to the Contractor.
- 2.3.5. The Contractor shall utilize the FPT procedures for any pre-testing activities prior to Functional Performance Testing.

2.4. INTEGRATED SYSTEMS TESTING PROCEDURES:

- 2.4.1. The purpose of the Integrated Systems Testing Procedures is to verify and document that all the integrated equipment and systems on the project perform together in accordance with the requirements in the Contract Documents and meet the Owner's Project Requirements.
- 2.4.2. The CxA shall develop specific script-type test procedures to verify and document proper operation of the integrated systems throughout the facility. The Contractor shall provide any supporting information to the CxA that may be needed including but not limited to product submittals, O&M information, and sequences of operation. Once developed, the CxA will issue to the Cx Team for review and comment.
- 2.4.3. The Commissioning Team shall review the Integrated Systems Testing procedures and submit written comments or questions to the CxA. The Contractor shall ensure that the sub-contractors and any vendors that would be involved with Integrated Systems Testing review the procedures and provide comments.
- 2.4.4. The CxA shall coordinate with the Cx Team to address any comments and produce the final IST procedures for acceptance by the Cx Team. The Contractor's acceptance shall constitute acceptance of all parties sub-contracted to the Contractor.

- 2.4.5. The CxA shall also develop the IST personnel matrix that will be utilized to track the individual testing teams involved with the IST. The CxA will distribute the matrix to the Cx Team so that the Contractor and Owner can assign the appropriate personnel to the appropriate teams.
- 2.4.6. The CxA shall also host a coordination meeting prior to the IST to review the IST procedures, complete any final coordination, review safety procedures, and answer any questions.
- 2.4.7. The CxA estimates there will be two Integrated Systems Tests on the project. The first will test the Data Center systems separately and the second will test the entire facility. Requirements of the testing are included in the respective technical sections of the Project Specifications.
- 2.4.8. The IST procedures shall be utilized by the Contractor for any pre-testing activities prior to official Integrated Systems Testing.

2.5. TRAINING PLAN

- 2.5.1. Contractor, in coordination with Owner and CxA, shall develop the Training Plan with project specific requirements for Owner Training, after reviewing the different systems to be installed and commissioned. The purpose of the Training Plan is to specifically communicate the required content and training durations required by the Owner based upon the type of equipment and the Owner's past experience.
- 2.5.2. The Contractor shall review all of the individual technical sections of this specification for specific training requirements.
- 2.5.3. The Contractor shall coordinate with the Owner to ensure that the proposed training requirements meet the Owner's needs and expectations.
- 2.5.4. The Contractor shall coordinate with the sub-contractors and vendors to ensure the Owner Training requirements can be achieved and gather any additional information or recommendations.
- 2.5.5. Any changes to the training requirements in this specification must follow contractual protocols.
- 2.5.6. The Training Plan shall include a list of systems and equipment for which training will be provided according to the three-tiered training approach outlined in the project specifications.
- 2.5.7. All training sessions shall have a syllabus indicating the following as a minimum in addition to any other specification requirements:
 - 2.5.7.1. Session Objectives
 - 2.5.7.2. Proposed Instructor(s)
 - 2.5.7.3. Instructor Qualifications
 - 2.5.7.4. Training Materials that will be provided
 - 2.5.7.5. Location and durations of the various parts of the training session (i.e., Classroom, On-site, etc.)
 - 2.5.7.6. Applicable specification sections and O&M Manual sections
 - 2.5.7.7. Detailed outline of training session content
- 2.5.8. The Contractor shall coordinate with the CxA to organize the systemic training sessions comparable

to the organization of the Systems Manual.

- 2.5.9. Owner training must be completed prior to the contractor obtaining substantial completion by the Owner.

2.6. FINAL COMMISSIONING PROCESS REPORT

- 2.6.1. The CxA shall prepare the Final Commissioning Process Report that will include the following:

- 2.6.1.1. Executive Summary
- 2.6.1.2. Participants and Roles
- 2.6.1.3. Brief building description
- 2.6.1.4. Overview of commissioning and testing scope
- 2.6.1.5. General description of testing and verification methods
- 2.6.1.6. Appendices with supporting information, issues log, and communications

- 2.6.2. The Contractor shall coordinate with the CxA to provide any additional information that may be needed to complete the Final Commissioning Process Report.

- 2.6.3. The Contractor shall resolve any outstanding commissioning items prior to the CxA preparing the final commissioning report.

- 2.6.4. The CxA shall issue the Final Commissioning Process Report to the Cx Team for review. The Owner shall approve the Final Commissioning Process report after any comments or discrepancies are resolved by the CxA.

PART 3- EXECUTION

3.1. PROJECT SCHEDULE

- 3.1.1. The Contractor shall integrate all Commissioning activities into the detailed Project Schedule. All parties will address scheduling problems and make necessary notifications in a timely manner to expedite the Commissioning Process.

3.2. COMMISSIONING TEAM MEETINGS

- 3.2.1. Upon obtaining Owner's approval of the Commissioning Plan, the CxA shall coordinate with the Cx Team to schedule, plan, and conduct a Pre-Commissioning Meeting with all parties involved in the Commissioning process. This meeting should include the major subcontractors, specialty manufacturers/suppliers, Architect/Engineer, Test, Adjust, and Balance (TAB) Firm, Electrical Testing Agency, and Owner's representatives as participants.

- 3.2.2. Contractor shall prepare for the Pre-Commissioning Meeting by supplying the following documents created by the CxA to all applicable sub-contractors and vendors: Commissioning Plan, Example System Verification Checklists, Example Functional Performance Test Procedures and Example Integrated Systems Test Procedures.

- 3.2.3. The CxA shall conduct the Pre-Commissioning Meeting and review all aspects of the Commissioning Plan and applicable specifications.

- 3.2.4. The Commissioning Plan shall be reviewed with all attendees and the scope of work discussed. Contractor should be prepared to distribute copies of the pertinent sections to the various subcontractors involved in the Commissioning process.
 - 3.2.5. The final outcome of the meeting shall be an understanding of the commissioning process, roles and responsibilities, and consensus acceptance of the Commissioning Plan by the Cx Team.
 - 3.2.6. The Contractor may request additional meetings with the CxA and individual sub-contractors to clarify roles, responsibilities and procedures as needed.
- 3.3. TEST EQUIPMENT
- 3.3.1. Contractor shall provide all specialized tools, test equipment and instruments required to execute start-up, checkout, and testing of equipment.
 - 3.3.2. All specialized tools, test equipment and instruments required to execute start-up, checkout, and testing of equipment shall be of sufficient quality and accuracy to test and/or measure system performance within specified tolerances. A testing laboratory must have calibrated test equipment within the previous twelve (12) months. Calibration shall be NIST traceable. Contractor must calibrate test equipment and instruments according to manufacturer's recommended intervals and whenever the test equipment is dropped or damaged. Calibration tags must be affixed to the test equipment or certificates readily available.
- 3.4. REPORTING
- 3.4.1. Beginning at the procurement stage for the equipment included in the Cx scope, the Contractor shall communicate at least monthly with all members of the Commissioning Team, keeping them apprised of construction progress and scheduling changes.
 - 3.4.2. Contractor shall submit Deficiency reports to the Owner within five (5) days of the deficiency occurrence. This includes responses to items noted by the Commissioning Authority.
- 3.5. DEFICIENCY RESOLUTION
- 3.5.1. The CxA shall document any issues noted during observation or testing activities in the Commissioning Issues Log (CxIL). The CxIL shall be distributed electronically to the Cx Team at regular intervals.
 - 3.5.2. The Contractor shall respond in writing to the CxA within 10 days to all new CxIL items regardless of the disposition. This response does not constitute a request for re-verification, only an acknowledgement of the outstanding item. The Contractor should utilize CxIL responses to update the Cx Team on the progress of deficiency resolution.
 - 3.5.3. The Contractor shall respond to the CxA and the Owner indicating CxIL items that are completed and ready for the CxA to verify completion.
 - 3.5.4. If any item indicated complete by the Contractor is found to be incomplete by the CxA upon re-verification the Contractor is responsible for all costs and additional compensation resulting from incomplete Cx Issues Log items.
- 3.6. REQUEST FOR ENERGIZING / START-UP OF EQUIPMENT
- 3.6.1. The Owner and/or Owner's representative may install lockout devices on equipment in addition to the Contractor's lockout / tagout devices once permanent power is connected to the facility. This lock would be removed once the proper start-up notification is received by the Owner and/or CxA, and the CxA has reviewed the appropriate SVCs and supporting documentation to verify the

equipment is ready for energizing and/or start-up.

- 3.6.2. These requirements do not supersede any additional requirements noted elsewhere in the Contract Documents or as required by applicable code authorities.
 - 3.6.3. Contractor shall notify Owner and CxA in writing to request initial energizing and/or start-up of equipment and systems at least 72 hours (not including weekends or holidays) prior to the scheduled start-up.
 - 3.6.4. Contractor shall complete the applicable sections of the System Verification Checklist(s) evidencing the Contractor's thorough inspection of the system and readiness for start-up activities as required by the Project Documents and the Commissioning Plan. Contractor shall submit required supporting documentation to the Owner and/or CxA, including but not limited to, factory testing reports, alignment reports, electrical testing reports and any other documentation required by the Project Documents prior to energizing and/or start-up.
 - 3.6.5. The CxA shall review the SVCs and supporting documentation within the 72-hour notice period and confirm in writing that the systems and equipment are approved to proceed with energizing and start-up.
 - 3.6.6. The CxA and/or owner may witness equipment energizing and/or start-up at the scheduled time, but witness is not required, unless noted elsewhere in the Specifications, as long as written approval is received as noted herein.
 - 3.6.7. Contractor shall perform Start-up under supervision of the responsible manufacturer's representative in accordance with manufacturer's instructions and Project Document requirements.
 - 3.6.8. Contractor shall complete all required factory start-up documentation and applicable items in the System Verification Checklists, prior to startup, to ensure compliance with the requirements in the Project Documents.
- 3.7. OPERATIONAL TESTING
- 3.7.1. Once the appropriate start-up activities are completed, the Contractor shall complete all necessary operational testing requirements included in the Project Documents prior to Functional Performance Testing. Specific requirements for systems and equipment are included in other technical sections of the Specifications.
 - 3.7.2. Contractor shall complete all operational testing items in the System Verification Checklist and submit all supporting documentation to the Owner and/or CxA for review.
 - 3.7.3. Contractor and manufacturer's representatives shall supervise and coordinate adjustments and balancing of all devices and systems for proper operation prior to requesting a Functional Performance Test(s).
 - 3.7.4. Contractor shall clearly list outstanding items or System Verification Checklist items not completed successfully. Contractor shall obtain from Subcontractor or vendor completed forms documenting any outstanding deficiencies within five (5) days of completion of energizing and/or start-up activities.
 - 3.7.5. Contractor shall review completed deficiencies to determine if outstanding items prevent execution of the Functional Performance Tests and shall issue any necessary responses to the Owner and/or Commissioning Authority.
 - 3.7.6. Contractor shall notify Owner and CxA in writing to request Functional Performance Testing of equipment and systems at least 72 hours (not including weekends or holidays) prior to the scheduled

activities. Owner may require Contractor to reschedule Functional Performance Testing to ensure availability of Owner's representative(s) as needed.

- 3.7.7. The CxA shall review the SVCs and supporting documentation within the 72-hour notice period and confirm in writing that the systems and equipment are approved to proceed with Functional Performance Testing.
- 3.7.8. If any item indicated complete by the Contractor is found to be incomplete by the CxA upon re-verification the Contractor is responsible for all costs and additional compensation resulting from incomplete System Verification Checklist items.

3.8. CONTROL POINT AND SENSOR CALIBRATION VERIFICATION

- 3.8.1. Automation systems installed on the project must be fully verified for point integrity and sensor calibration prior to Functional Performance Testing. Additional requirements for this verification are listed in other technical sections of the Specifications.
- 3.8.2. The Contractor shall verify these points according to the requirements in the project documents as part of start-up and operational testing of systems.
- 3.8.3. The TAB contractor shall independently verify each sensor and point and document the results to be included in the Final TAB Report.
- 3.8.4. The CxA will witness, at their discretion, this verification and/or independently verify and document the results to be included in the Final Commissioning Process Report.
- 3.8.5. These activities must be completed prior to the Contractor requesting Functional Performance Testing as indicated herein.

3.9. FUNCTIONAL PERFORMANCE TESTING

- 3.9.1. The objective of Functional Performance Testing is to demonstrate that each system operates according to the requirements in the Project Documents and meets the OPR and BOD.
- 3.9.2. Contractor shall operate, or cause to be operated, each system, device, or equipment item, both intermittently and continuously, for a duration period as indicated in the Specification Section(s) for each item and/or in accordance with the Project Documents, the Commissioning Plan and applicable Functional Performance Testing procedures.
- 3.9.3. Contractor shall operate each component device and each building system to the full extent of its capability, from minimum to maximum, and under automatic control and manual control.
- 3.9.4. The CxA and members of the Cx Team, including the Owner's personnel, may observe Functional Performance Testing of equipment components and systems. The CxA shall facilitate the Functional Performance Testing activities according to the accepted FPT procedures and record the results of all testing activities.
- 3.9.5. The CxA shall record any deficiencies noted during the testing in the CxIL. If significant deficiencies exist, the owner and/or CxA may request that the testing activities be terminated and re-scheduled after proper verification by the Contractor. The Contractor is responsible for all costs and additional compensation resulting from deficiencies and incomplete systems noted during scheduled Functional Performance Testing.
- 3.9.6. All Functional Performance Testing of Integrated Systems must be completed in accordance with the Project Documents and the Commissioning Plan prior to the Contractor scheduling the Integrated Systems Testing activities.

3.10. INTEGRATED SYSTEMS TESTING

- 3.10.1. The objective of Integrated Systems Testing is to demonstrate that each integrated system operates jointly and/or independently of other systems according to the requirements in the Contract Documents.
- 3.10.2. Contractor shall operate each system, jointly and independently of other systems, through selected modes of operation (fire alarm integration with HVAC, emergency power modes, equipment failures among related systems, etc.) according to the accepted Integrated Systems Testing procedures developed by the CxA. The CxA shall facilitate and document the testing, organizing the appropriate testing teams and providing sufficient instruction to all participants to conduct efficient and effective testing activities.
- 3.10.3. Integrated Systems Testing typically involves multiple teams with representation from the CxA, Owner, and Contractor. The Contractor shall provide any needed communication equipment (i.e., radios) or make available any centralized intercom or paging system for communication with all testing groups.
- 3.10.4. The Contractor shall provide no less than 7 days (not including weekends or holidays) notice when requesting to conduct the Integrated Systems Testing. All personnel must be assigned to the Personnel Matrix by the CxA and a coordination meeting held within the 7 day period as prescribed elsewhere in this section.
- 3.10.5. Contractor conducts Integrated Systems Testing after all applicable Functional Performance Testing is satisfactorily completed and approved by the Owner and/or CxA.
- 3.10.6. The CxA shall record any deficiencies noted during the testing in the CxIL. If significant deficiencies exist, the owner and/or CxA may request that the testing activities be terminated and re-scheduled after proper verification by the Contractor. The Contractor is responsible for all costs and additional compensation resulting from deficiencies and incomplete systems noted during scheduled Integrated Systems Testing.

3.11. DEMONSTRATION AND OWNER TRAINING

- 3.11.1. The Contractor, in coordination with Owner and CxA, shall develop the Training Plan with project specific requirements for Owner Training as required throughout various sections of the Project Specifications.
- 3.11.2. The specific requirements for scheduling and conducting the Owner Training are included in other sections of this Specification.
- 3.11.3. Owner Training activities shall not occur until the Training Plan is approved by the Owner and the Contractor has submitted all O&M information for review and use during the training sessions.
- 3.11.4. The Contractor shall notify the CxA of all training sessions. The Contractor shall record attendance of the training sessions and the Owner shall ensure the appropriate personnel are in attendance.
- 3.11.5. The CxA shall ensure the content of the Owner Training sessions meets the requirements in the Project Documents.
- 3.11.6. The CxA may conduct surveys of the Owner's personnel to gauge the effectiveness of the Owner training sessions. If unfavorable surveys are received by the Owner's personnel indicating unsatisfactory training, the Owner reserves the right to require the Contractor to re-train in those specific areas of non-conformance until the requirements in the Project Documents are satisfactorily completed.

- 3.11.7. Owner training must be completed prior to the contractor obtaining substantial completion by the Owner.
- 3.12. DEFERRED / SEASONAL TESTING
 - 3.12.1. All Construction phase requirements of the Commissioning Process must be completed prior to Substantial Completion or as indicated elsewhere in this Specification.
 - 3.12.2. If any testing or other requirements cannot be completed prior to Substantial Completion due to the building structure, required occupancy condition, or other condition, performance of such test may be delayed to later in the warranty period, upon approval of the Owner. Contractor shall reschedule testing according to the protocols described in this section and any other operational protocols prescribed by the Owner.
 - 3.12.3. Contractor shall complete all outstanding commissioning requirements as part of this Contract during the warranty period. Contractor shall schedule all activities with Owner and/or CxA.
 - 3.12.4. The CxA shall document any deferred testing activities and ensure the appropriate commissioning documents are updated. The Contractor shall provide any additional documentation needed by the CxA to complete these requirements.

END OF SECTION

CFISD Cypress Ridge High School Additions

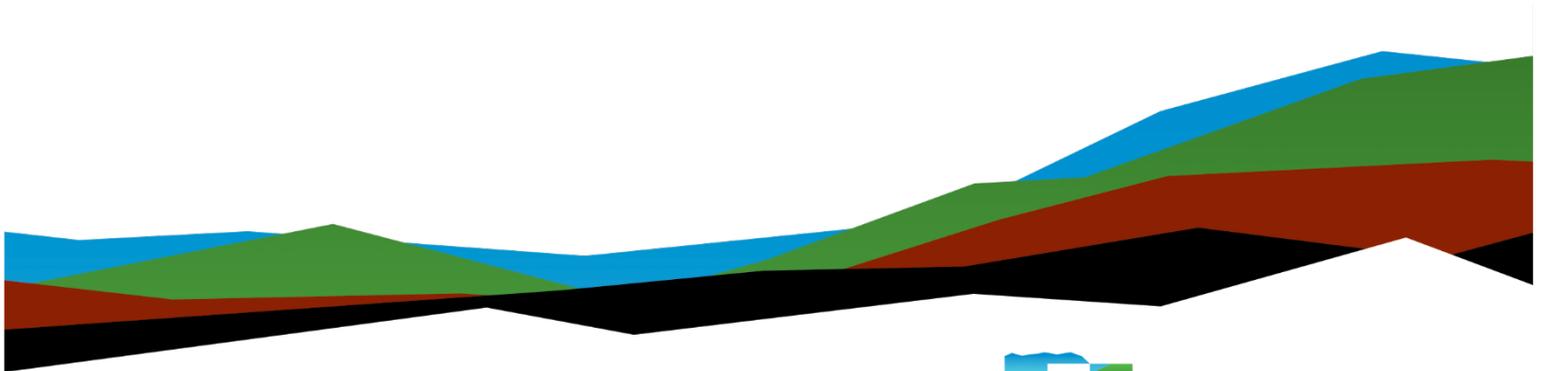
Geotechnical Engineering Report

September 30, 2024 | Terracon Project No. 92245375

Prepared for:

Page

1100 Louisiana Street, Suite 1
Houston, Texas 77002



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September 30, 2024

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Attn: Ms. Mariela Flores, AIA, NCARB – Associate Architect
P: (713) 871-8484
E: mflores@pagethink.com

Re: Geotechnical Engineering Report
CFISD Cypress Ridge High School Additions
7900 North Eldridge Parkway
Houston, Texas
Terracon Project No. 92245375

Dear Ms. Flores:

Terracon Consultants, Inc. (Terracon) is pleased to submit our geotechnical engineering report for the project referenced above in Houston, Texas. We trust that this report is responsive to your project needs.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report or if we may be of further service, please contact us.

Sincerely,

Terracon Consultants, Inc.
(Texas Firm Registration No.: F-3272)

Jonathan N. Han, E.I.T.
Staff Geotechnical Engineer

Ranadeep Ravula, P.E.
Group Manager

Bobbie S. Hood, P.E.
Senior Engineer (Conroe)



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- Exploration and Testing Procedures
- Site Location and Exploration Plans
- Exploration and Laboratory Results
- Supporting Information

Geotechnical Engineering Report

CFISD Cypress Ridge High School Additions | Houston, Texas
September 30, 2024 | Terracon Project No. 92245375



Note: This report was originally delivered in a web-based format. **Blue Bold** text in the report indicates a referenced section heading. The PDF version also includes hyperlinks which direct the reader to that section and clicking on the  logo will bring you back to this page. For more interactive features, please view your project online at client.terracon.com.

Refer to each individual Attachment for a listing of contents.

Introduction

Terracon Consultants, Inc. (Terracon) is pleased to submit our geotechnical engineering report for the proposed construction of the proposed improvements within the existing Cypress Ridge High School located at 7900 North Eldridge Parkway in Houston, Texas. This project was authorized by Ms. Mariela Flores, Associate Architect of Page through electronic correspondence on August 5, 2024. This project was performed in general accordance with Terracon Document No. P92245375, dated July 24, 2024.

The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- Earthwork recommendations including site/subgrade preparation;
- Foundation design parameters and construction recommendations;
- LPILE parameters; and
- Pavement design guidelines.

The geotechnical engineering Scope of Services for this project included the advancement of seven test borings to depths that ranged from approximately 20 to 30 feet below existing grade.

Maps showing the site and boring locations are shown in the [Site Location](#) and [Exploration Plan](#) sections, respectively. The results of the laboratory testing performed on soil samples obtained from the site during the field exploration are included on the boring logs in the [Exploration Results](#) section.

Site Conditions

The following description of site conditions was derived from our site visit in association with the field exploration.

| Item | Description |
|------------------------------|--|
| Project Location | The project site is located within the existing Cypress Ridge High School campus located at 7900 North Eldridge Parkway in Houston, Texas. See Site Location . |
| Existing Improvements | The site was occupied by an existing school building, tennis courts, sports fields, and associated pavements at the time of our field program. |
| Current Ground Cover | Grass, weeds, concrete pavements, and scattered trees. |

| Item | Description |
|----------------------------|-------------------|
| Existing Topography | Relatively level. |

Project Description

Our initial understanding of the project was provided in our proposal and was discussed during project planning. A period of collaboration has transpired since the project was initiated, and our final understanding of the project conditions is as follows:

| Item | Description |
|--|--|
| Proposed Improvements¹ | <ul style="list-style-type: none"> ■ A single-story building addition planned on the southeast corner of the existing building with an approximate footprint area of 10,500 square feet (sf). ■ A single-story building addition planned on the southwest corner of the existing building with an approximate footprint area of 750 sf. ■ A new athletics storage building planned north of the existing athletic track with an approximate footprint of 1,500 square feet. ■ Tennis courts and associated light poles. ■ Associated pavements. |
| Building Construction | Either steel-frame or concrete masonry unit (CMU) construction. |
| Finished floor Elevation | <ul style="list-style-type: none"> ■ Athletics Storage Building: Within approximately one to two feet above existing grade. ■ Building Additions: Within approximately one foot above existing grade and to match the finished floor elevation of the existing building. |
| Maximum Loads (Assumed) | <ul style="list-style-type: none"> ■ Column loads: 75 to 100 kips. ■ Floor slab pressure: 125 pounds per square foot (psf). |
| Planned Foundation Systems | <ul style="list-style-type: none"> ■ Buildings: Drilled-and-underreamed footings ■ Tennis Courts: Post-tensioned (PTI) slab-on-grade ■ Light Poles: Drilled straight shafts |

| Item | Description |
|--|--|
| <p>Pavements</p> | <p>We understand portions of the existing pavements are planned to be replaced with a new rigid (concrete) pavement section. We anticipate that traffic will consist primarily of passenger vehicles in the parking areas and passenger vehicles combined with garbage trucks, and large multi-axle delivery trucks and buses from time-to-time in driveway areas.</p> |
| <p>1. Based on the information provided by Page.</p> | |

Geotechnical Characterization

Geology

Based on the geologic maps published by the Bureau of Economic Geology, the site for the proposed project is located on the upper Lissie formation, sometimes denoted the Montgomery formation. The upper Lissie formation is heterogeneous, containing interbedded layers of clay, sand and silt. This formation was deposited in mid-Pleistocene time in shallow coastal river channels and flood plains.

The clay present in the formation has been preconsolidated by a process of desiccation. Numerous wetting and drying cycles have produced a network of randomly oriented and closely-spaced joints, which are sometimes slickensided, that is, have a shiny appearance when exposed. The joint pattern strongly influences the engineering behavior of the soil.

The sand layers vary in compactness from loose to very dense, and in thickness from a fraction of an inch to many feet due to an irregular depositional environment. Sands are generally subrounded to subangular and vary from coarse to very fine, are poorly graded, and often contain significant amounts of silt-sized particles in the sand matrix.

The coastal plain in this region has a complex tectonic geology, several major features of which are: Gulf Coastal geosyncline, salt domes, and major sea level fluctuations during the glacial stages, subsidence and geologic faulting activities. Most of these geologic faulting activities have ceased for millions of years, but some are still active. A detailed geologic fault investigation and study of the site geology are beyond the scope of this report.

Subsurface Profile

We have developed a general characterization of the subsurface conditions based upon our review of the subsurface exploration, laboratory data, geologic setting and our understanding of the project. This characterization, termed GeoModel, forms the basis of

our geotechnical calculations and evaluation of the site. Conditions observed at each exploration point are indicated on the individual logs. The individual logs can be found in the [Exploration Results](#) and the GeoModel can be found in the [Figures](#) attachment of this report.

As part of our analyses, we identified the following model layers within the subsurface profile. For a more detailed view of the model layer depths at each boring location, refer to the GeoModel.

| Model Layer | Layer Name | General Description |
|-------------|--------------------------------------|--|
| 1 | Fill: Sandy Lean Clay | dark gray and tan, with calcareous nodules, sand pockets, and scattered roots |
| 2 | Sandy Lean Clay and Lean Clay | dark gray, light gray, and tan, medium stiff to very stiff, with calcareous nodules and ferrous stains |
| 3 | Fat Clay | dark gray, light gray, reddish brown, and tan, very stiff, with sand pockets |
| 4 | Silty Sand | light gray, dense to very dense |

Laboratory Data

Hydrometer tests were performed on two soil samples from borings B-5 and B-6 drilled in the area of the proposed tennis courts. Results of the hydrometer tests are presented in the table below.

| Hydrometer Analyses | | | | | |
|---------------------|---------------------|---------------------|------------------|-----------------------------------|---|
| Boring No. | Sample Depth (feet) | Description | Plasticity Index | Percentage Fines (%) ¹ | Percent Finer Than 2 Microns (%) ² |
| B-5 | 2 to 4 | Lean Clay with Sand | 17 | 71 | 24 |
| B-6 | 4 to 6 | Lean Clay with Sand | 14 | 71 | 25 |

1. Percent passing the No. 200 sieve.
2. Computed clay content of the soils has been used for the computation of the edge and center lift movements for the design of post-tensioned slabs-on-grade.

Groundwater Conditions

Borings B-1 through B-7 were advanced using dry drilling techniques to a depth of approximately 20 to 30 feet in an effort to evaluate groundwater conditions at the time of

our field program. Groundwater was initially observed at borings B-5 through B-7 at a depth of about 30 feet during dry drilling. After a 15-minute monitoring period, groundwater was observed at borings B-5 through B-7 at depths that varied from about 17 to 18 feet. Groundwater was not observed at borings B-1 through B-4 during or upon completion of drilling.

Groundwater level fluctuations occur due to seasonal variations in the amount of rainfall, runoff and other factors not evident at the time the borings were performed. Therefore, groundwater levels during construction or at other times in the life of the structures may be higher or lower than the levels indicated on the boring logs. The possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the project and should be evaluated prior to construction.

Geotechnical Overview

Based on the information obtained from our subsurface exploration, the site can be developed for the proposed project. A summary of our findings and recommendations is provided below.

- Fill soils were observed at the ground surface at borings B-1 through B-4 and B-7 and extended to depths that varied from about 2 to 4 feet. Fill soils may be present at varying depths and at other locations not explored during our field program. Support of the foundation elements, slabs, flatworks, and pavements on or above fill soils is discussed in this report. However, even with the recommended construction testing services, an inherent risk exists for the owner that compressible fill or unsuitable material within or buried by the fill will not be discovered. This risk of unforeseen conditions cannot be eliminated without completely removing the existing fill.
- Due to the amount of fill observed at this site, the fill soils should be over-excavated and completely removed within the proposed structure areas to expose the underlying native subsurface soils. Select fill soils should be used to raise grade up in the proposed structure areas.
- The surficial soils observed in portions of the site exhibited low plasticities and an increased silt and sand content. These soils are moisture sensitive and may become weak with elevated moisture contents and present construction difficulties. If wet and/or soft conditions are present at the time of construction, remedial efforts may be necessary for preparation of the surficial soils in the structure and pavement areas to create a working surface. Remedial effort options are discussed in the **Wet Weather/Soft Subgrade** section of this report.

- A foundation system consisting of drilled-and-underreamed footings may be utilized to support the proposed building and building additions planned at this site.
- A post-tensioned (PTI) slab-on-grade foundation system may be utilized to support the proposed tennis courts planned at this site.
- A foundation system consisting of drilled straight-shafts may be utilized to support the proposed light poles planned at this site.
- Based on the subsurface conditions observed, the installation of the drilled straight shafts will likely receive the use of Slurry Displacement Method and/or temporary steel casing to help control any groundwater seepage and/or sloughing of the sidewalls.
- A minimum 12-inch thick select fill pad should be placed under the proposed structure areas to provide uniform support to the floor slab.
- The PTI design parameters provided in this report are based on existing soil conditions and/or soils with similar characteristics as the on-site soils. Import fill, if planned to raise grade at the site for a post-tensioned slab-on-grade, should have similar classification, moisture content, and density as the adjacent in-situ soils and may be used provided it is free of organics and debris.
- Rigid pavement sections vary from 5.0 to 7.0 inches of reinforced concrete with chemically treated subgrade.

This summary should be used in conjunction with the entire report for design purposes. Details were not included or fully developed in this section, and the report must be read in its entirety for a comprehensive understanding of the items contained herein. The section titled **General Comments** should be read for an understanding of the report limitations.

Earthwork

Earthwork is anticipated to include clearing and grubbing, excavations, and fill placement. The following sections provide recommendations for use in the preparation of specifications for the work. Recommendations include critical quality criteria, as necessary, to render the site in the state considered in our geotechnical engineering evaluation for foundations, floor slabs, and pavements.

Site Preparation

Construction areas should be stripped of vegetation, topsoil, trees, existing pavements and other debris/unsuitable surface material. Roots of trees to be removed within the

construction areas should be grubbed to full depths. Care should be taken to replace or recompact all soil removed or loosened by the removal of tree roots and stumps as recommended in subsequent paragraphs. Proper site drainage should be maintained during construction so that ponding of surface runoff does not occur and cause construction delays and/or inhibit site access.

Due to the amount of the fill observed at portions of the site, we recommend that the fill soils be over-excavated and completely removed within the proposed structure areas to expose the underlying native subsurface soils. Select fill soils should be used to raise grade up in the proposed structure areas.

Once final subgrade elevations have been achieved, the exposed subgrade should be carefully proofrolled with a 20-ton pneumatic roller or equivalent equipment, such as a fully loaded dump truck, to detect weak zones in the subgrade. Special care should be exercised when proofrolling areas containing fill soils in an attempt to observe soft/weak zones within the fill soils. Weak areas detected during proofrolling, as well as zones of fill containing organic matter and/or debris, should be removed and replaced with soils exhibiting similar classification, moisture content, and density as the adjacent in-situ soils. Proofrolling should be performed under the direct observation of the geotechnical engineer or his/her representative.

Subsequent to proofrolling, and just prior to placement of fill, the exposed subgrade within the construction area should be evaluated for moisture and density. If the moisture and/or density do not meet the criteria described in **Fill Compaction Requirements** for on-site soils, the subgrade should be scarified to a minimum depth of 6 inches, moisture adjusted, and compacted to at least 95 percent of the Standard Effort (ASTM D 698) maximum dry density.

Fill Material Types

Select fill and on-site soils to be used at this site for grade adjustments should meet the following criteria:

| Fill Type | USCS Classification | Acceptable Location for Placement |
|-------------------|--|---|
| Select Fill Soils | CL and/or SC ($10 \leq PI \leq 20$) | Must be used to construct the select fill pad under the floor slabs and for all grade adjustments within the structure areas. |

| Fill Type | USCS Classification | Acceptable Location for Placement |
|---------------|---------------------|--|
| On-site Soils | Varies | <ul style="list-style-type: none"> ■ The on-site soils, including the undocumented fill soils, appear suitable for use as fill within the pavement areas, provided they are free of organics and debris. ■ PTI structure area should be accomplished with on-site soils or exhibiting similar classification, moisture content, and density as the adjacent in-site soils provided they are free of organics and debris. |

If blended or mixed soils are intended for use as select fill, Terracon should be contacted to provide additional recommendations. Blended or mixed soils do not occur naturally. These soils are a blend of sand and clay and will require mechanical mixing at the site with a pulvimixer. If these soils are not mixed thoroughly to break down the clay clods and blend-in the sand to produce a uniform soil matrix, the fill material may be detrimental to the performance of the foundations. If blended soils are used, we recommend that additional samples of the blended soils as well as the clay clods, be obtained prior to and during earthwork operations to evaluate if the blended soils can be used in lieu of select fill. The actual type and amount of mechanical mixing at the site will depend on the amount of clay and sand, and properties of the clay.

Fill Compaction Requirements

| Item | Description |
|--------------------------------|---|
| Fill Lift Thickness | The fill soils should be placed on prepared surfaces in lifts not to exceed 8 inches loose measure, with compacted thickness not to exceed 6 inches. |
| Compaction Requirements | The select fill and on-site soils should be compacted to at least 95 percent of the Standard Effort (ASTM D 698) maximum dry density and should be moisture adjusted to within 2 percent of the optimum moisture content. |

Prior to any filling operations, samples of the proposed borrow and on-site materials should be obtained for laboratory moisture-density testing. The tests will provide a basis for evaluation of fill compaction by in-place density testing. A qualified soil technician should perform sufficient in-place density tests during the filling operations to evaluate that proper levels of compaction, including dry unit weight and moisture content, are being attained.

Utility Trench Backfill

Utility trenches are a common source of water infiltration and migration. All utility trenches that penetrate beneath the structure should be effectively sealed to restrict water intrusion and flow through the trenches that could migrate below the building. We recommend constructing an effective clay “trench plug” that extends at least 5 feet out from the face of the building exterior. The plug material should consist of clay compacted at a water content at or above the soils optimum water content. The clay fill should be placed to completely surround the utility line and be compacted in accordance with recommendations in this report.

Grading and Drainage

All grades must provide effective drainage away from the structures during and after construction. Water permitted to pond next to the structures can result in distress in the structures. These greater movements can result in unacceptable differential floor slab movements, cracked slabs and walls, and roof leaks. Building slab and foundation performances described in this report are based on effective drainage for the life of the structures and cannot be relied upon if effective drainage is not maintained.

Exposed ground should be sloped away from the structures for at least 10 feet beyond the perimeter of the structures. After building construction and landscaping, we recommend verifying final grades to document that effective drainage has been achieved. Grades around the structures should also be periodically inspected and adjusted as necessary, as part of the structures’ maintenance program.

Planters located within 10 feet of the proposed structures should be self-contained to prevent water accessing the building and pavement subgrade soils. Locate sprinkler mains and spray heads a minimum of 5 feet away from the building lines. Low-volume, drip-style landscaped irrigation should not be used near the structures. Collect roof runoff in drains or gutters. Discharge roof drains and downspouts onto pavements and/or flatworks which slope away from the proposed structures or extend down spouts a minimum of 10 feet away from structures.

Flatworks and pavements will be subject to post construction movement. Maximum grades practical should be used for paving and flatwork to prevent water from ponding. Allowances in final grades should also consider post-construction movement of flatwork, particularly if such movement would be critical. Where paving or flatwork abuts the building, effectively seal and maintain joints to prevent surface water infiltration.

Wet Weather/Soft Subgrade Considerations

Due to the elevated silt and sand content and low plasticities of the surficial soils observed at portions of this site, proper compaction may be difficult to achieve. In addition, construction during and soon after wet weather periods may encounter difficulties due to wet and soft surficial soils becoming a general hindrance to equipment as a result of rutting and/or pumping of the soil surface. This condition is primarily due to their lack of cohesion (low clay content) and little to no confining pressure near the ground surface. If the subgrade cannot be adequately compacted to the minimum densities as described above, one of the following methods should be used to improve the soils: 1) removal and replacement with select fill, 2) chemical treatment of the soil to dry the subgrade, or 3) drying by natural means if the schedule allows.

Based on our experience with similar soils, chemical treatment is an efficient and effective method to improve the condition of wet and soft subgrade such as that observed at this site. Chemical treatment may be necessary to depths of approximately one to 2 feet or greater of the surficial silty/sandy soils, depending on the condition of the subgrade at the time of construction. We suggest that a cost be included in the construction budget for chemical treatment of the soils using a lime-flyash mixture to aid drying and improve the condition of the soil if the soil is wet and/or soft at the time of construction. We recommend that this cost be in the form of a contingency or allowance to be used if needed.

Foundation Systems

Based on the subsurface conditions observed during our field and laboratory programs, a foundation system consisting of drilled-and-underreamed footings, a PTI slab-on-grade, and drilled straight shafts may be utilized to support the proposed tennis courts, structures, and light poles, respectively, planned at this site, provided the subgrade is properly prepared as described in this report. Recommendations for these types of foundation system are provided in the following sections, along with other geotechnical considerations for this project.

Design Recommendations – Drilled-and-Underreamed Footings

| Item | Description |
|--|---|
| Minimum Embedment Depth ¹ | 8 feet below existing grade (grade at the time of our field program) |
| Allowable Bearing Pressures ² | Net dead plus sustained live load – 4,000 psf Net total load – 6,000 psf |
| Maximum Underream-to-Shaft Diameter Ratio | 3:1 |

| Item | Description |
|--|---|
| Approximate Post-Construction Settlement ³ | One inch or less |
| Estimated Differential Settlement ⁴ | Approximately ½ of post-construction settlement |
| Allowable Passive Pressure ⁵ | 1,000 psf |
| Uplift Resistance ⁶ | Foundation Weight (150 pcf) & Soil Weight (120 pcf) |

1. The footings should bear within the undisturbed native clay soils.
2. Whichever condition yields a larger bearing area.
3. This estimated post-construction settlement of the footings is without considering the effect of stress distribution from adjacent foundations and assuming proper construction practices are followed. A clear distance between the footings of one underream diameter of the larger footing (new and existing) should be provided between the underreams to develop the recommended bearing pressures and to control settlements. If a clearance of one diameter cannot be maintained in every case, the above bearing capacities should be reduced by 20 percent for a clearance between one half and one underream diameters. Underreams closer than a clearance of one half of an underream diameter are not recommended.
4. The differential settlement will result from variances in subsurface conditions, loading conditions and construction procedures, such as cleanliness of the bearing area or flowing water in the shaft.
5. For footings placed against an undisturbed vertical face of the in-situ soils. Lateral resistance of the drilled-and-underreamed footings is primarily developed by passive resistance of the soils against the side of the footing. Due to surface effects, the lateral resistance of the upper 3 feet of the soils at the surface for exterior footings should be neglected unless area paving is provided up to the edge of the buildings.
6. Structural uplift loads on the drilled-and underreamed footings will be resisted by the dead weight of the footings and supported structure plus the weight of a soil wedge above the footing. The soil wedge can be assumed to extend upward from the bottom of the underream at a slope of 4 vertical to 1 horizontal.

Construction Considerations – Drilled-and-Underreamed Footings

Drilled excavations to a depth of 8 feet below existing grade will be necessary for installation of drilled-and-underreamed footings for the proposed structures planned at this site. The excavations should be performed with equipment capable of providing a relatively clean bearing area. The presence of secondary structures such as calcareous nodules, sand pockets, ferrous stains, etc., can cause sloughing during footing excavation. Thus, the drilling contractor should have casing available in the event that sloughing causes improperly formed shafts.

Based on our groundwater observations (refer to **Groundwater Conditions**), groundwater is not expected to be a major concern during construction at the recommended bearing depth. However, depending on climatic conditions, groundwater levels may vary from the levels observed during our field program. Water must not be allowed to accumulate in

the bottom of the footing excavations. The contractor should be prepared to remove water from the drilled footings, if necessary. To reduce the potential for water seepage into the footing excavation and to minimize disturbance to the bearing area, we recommend that concrete and steel be placed as soon as possible after footing excavations are completed. Preferably, footing excavations should be backfilled with concrete within about 2 to 4 hours of completion of the drilling and in no case should an excavation be left open overnight. The concrete placed in the excavations should have a 6-inch slump with a plus or minus one inch tolerance. The bottom of each footing excavation should be free of all loose materials and/or water, and the bearing surface should be evaluated immediately prior to placing concrete.

Based on the available field and laboratory data, the underreams constructed as described in this report should remain stable for a short period of time. However, if underreams are marginally stable due to water seepage and/or the presence of sloughing soils, successful construction of underreamed footings may be possible by performing the sequence of construction without interruption, that is, each footing drilled, underreamed, and backfilled with concrete in one continuous operation. The contractor must coordinate the operation very closely to have concrete on site at the time each footing is drilled and underreamed so that no shaft or underream is drilled without concrete standing by, ready to be placed. Additional measures to reduce the potential for caving of the underream would be to limit the underream-to-shaft diameter ratio to 2.5:1 or 2:1 or to install straight shaft footings in isolated problem areas. If straight-shaft footings are planned at the site, Terracon should be contacted for additional recommendations.

Grade Beams – Drilled-and-Underreamed Footings

Grade beams associated with the drilled-and-underreamed footings should be designed to span between the footings without subgrade support. Backfill against the outside face of the grade beams should consist of select fill used to prepare the building pad. The select fill should be uniformly compacted to at least 95 percent of the Standard Effort (ASTM D698) maximum dry density at a moisture content within 2 percent of optimum moisture content.

Design Recommendations – Post-Tensioned (PTI) Slab-on-Grade

Based on our analysis of the field and laboratory data, design parameters were computed using Addenda No. 1¹ and No. 2² to the 2004 Post-Tensioning Institute (PTI) method for slab-on-grade design. The moisture beneath a shallow foundation will change in response to wetting and drying conditions around the foundation perimeter. The maximum moisture variation distance is termed the edge moisture variation distance, e_m , and is an important factor governing the design of a post-tensioned floor slab. The e_m is related to percent fine clay and climatic conditions as well as other parameters, such as soil fabric factor and unsaturated diffusion coefficient.

The plasticity index of the soil, type and amount of clay mineral in the soil, and the moisture conditions from the time of construction through the life of the structure are parameters that should be considered in design of a slab-on-grade. The plasticity index and the clay mineral are values of the soil that can be estimated by laboratory tests and, although variable from location to location, remain relatively constant with time. The moisture condition has a significant effect on slab behavior and is highly variable with time, changing seasonally, with annual climate conditions, drainage patterns, ground cover, and vegetation (trees and shrubs).

Based on our laboratory test data and on our experience with similar soils, the post-tensioned slabs at this site should be designed using criteria outlined by the Post-Tensioning Institute using the following parameters:

¹. Post-Tensioning Institute, "Addendum No. 1 to the 3rd Edition of the Design of Post-Tensioned Slabs-on-Ground", Post-Tensioning Institute, Phoenix, AZ, May 2007.
². Post-Tensioning Institute, "Addendum No. 2 to the 3rd Edition of the Design of Post-Tensioned Slabs-on-Ground", Post-Tensioning Institute, Phoenix, AZ, May 2008.

| Item | Description |
|---|--|
| Depth of Seasonal Moisture Change | Approximately 9 feet |
| Effective Plasticity Index | 22 |
| Percent Finer than 2 Microns ¹ | 24 to 25 |
| Soil Fabric Factor | 1.0 |
| Approximate Thornthwaite Moisture Index ² | +15 |
| Estimated Constant Soil Suction, pF | 3.5 pF |
| Range of Soil Suction, pF ² | 3.0 to 4.5 pF |
| Estimated Edge Moisture Variation Distance, e_m ³ | For center lift: 8.7 feet For edge lift: 4.7 feet |
| Estimated Differential Soil Movement, y_m ³ | For center lift: 0.7 inch For edge lift: 0.4 inches |
| Allowable Bearing Capacity ⁴ | Dead load plus sustained live load: 1,200 psf Total net load: 1,500 psf |

1. For varying soil properties to 9 feet.
2. The differential movements were calculated by modeling the soil profile using the commercial software program VOLFLO as recommended by the PTI manual. Based on a Thornthwaite Index of +15 for this site, we considered the Post-Equilibrium Case to determine the Stress Change Factor (SCF). As recommended by the PTI manual, a suction change of 1.5 pF was used for the analysis for the Post- Equilibrium Case.
3. The estimated movements do not consider the effects of non-climatic factors which might arise from conditions beyond the control of Terracon. The conditions include, but are not limited to, location of planters and trees around the building, poor drainage, and operations of the owner/contractor on the site subsequent to our explorations.
4. Provided the subgrade is prepared as recommended in the **Earthwork** section of this report.

Post construction settlements for the slab foundation described in this subsection should be one inch or less, provided the site is prepared as described in this report. Settlement response of the foundation system is expected to be influenced more by the quality of construction and fill placement than by soil-structure interaction.

Construction Considerations – Post-Tensioned Slab-on-Grade

The excavations for slabs should be performed with equipment capable of providing a relatively clean bearing area. The bottom 6 inches of the planned foundation excavations should be performed using a smooth-mouthed excavation bucket or hand labor. The excavations should be neatly excavated and properly formed. Debris in the bottom of the

excavations should be removed prior to steel placement. Water should not be allowed to infiltrate foundation excavations.

To reduce the potential for groundwater seepage into the excavations and to minimize disturbance to the bearing area, we recommend that steel and concrete be placed as soon as possible after the excavations are completed and properly cleaned. Excavations should not remain open overnight. The bearing surface of the foundation should be evaluated upon completion of the excavation and immediately prior to placing concrete.

Design Recommendations – Drilled Straight Shaft Foundations

The drilled straight shafts planned for the proposed light poles should be designed to resist both horizontal and vertical forces. Horizontal forces can be resisted by the passive pressure of soil acting on the vertical face of the drilled straight shafts. Vertical downward forces can be resisted by the allowable end bearing pressure of the soils at the bottom of the drilled straight shafts. Vertical uplift forces can be resisted by the dead weight of the poles and its foundation. When foundation concrete is cast in direct contact with excavation sides, an allowable side friction value can also be used to resist vertical loads.

The allowable design criteria for utilization of drilled straight shafts as the foundation system for the proposed light poles are presented in the following table. The table includes the effective soil unit weights, shear strength parameters, allowable end bearing pressure, lateral passive pressure and side friction values. Furthermore, the lateral subgrade modulus values are provided for the cyclic and static loading conditions. Care should be exercised to utilize the appropriate loading condition in the analysis.

The design parameters presented in the following table are applicable for the natural, undisturbed soils. The capacity of the upper 4 feet of the on-site soils should be disregarded due to surface effects and presence of expansive soils. Drilled straight shafts should extend at least 2 feet or half a shaft diameter, whichever is greater, into the desired bearing strata in order to use the recommended allowable end bearing pressures. The design parameters provided were calculated assuming groundwater is below 15 feet.

Long-term settlement of the drilled straight shaft foundation, designed and constructed in accordance with the recommendations presented in this report, should be about one inch or less.

| Design Parameters for Drilled Straight Shaft Footings | | | | | | | | |
|---|-----------------------------|--|---|---|--------|--------------------------------|--------------------------------|-------------------------------------|
| Below Existing Grade (feet) ¹ | Effective Unit Weight (pcf) | Allowable Unit Skin Friction Resistance (psf) ³ | Allowable End Bearing Pressure (psf) ² | Lateral Subgrade Modulus (pci) ⁴ | | Strain ϵ_{50} (in/in) | Undrained Shear Strength (psf) | Angle of Internal Friction (degree) |
| | | | | Static | Cyclic | | | |
| 0 to 4 | 130 | Disregard | | | | | | |
| 4 to 10 | 130 | 275 | Disregard | 500 | 175 | 0.007 | 1,000 | --- |
| 10 to 15 | 130 | 385 | 4,500 | 575 | 200 | 0.007 | 1,500 | --- |
| 15 to 28 | 58 ⁵ | 550 | 6,000 | 700 | 275 | 0.007 | 2,000 | --- |
| 28 to 30 | 63 ⁵ | 700 | 8,000 | 90 | 90 | --- | --- | 32 |

1. Grade at the time of our field program.
2. The net allowable end bearing pressure refers to the pressure at the foundation bearing level in excess of the surrounding overburden pressure. A minimum penetration of 4 feet or one-half a shaft diameter, whichever is greater, into the desired bearing strata should be achieved with a minimum of 4 feet of the selected bearing stratum beneath the shaft tip to use the recommended allowable end bearing pressure.
3. The allowable side friction is based on a rectangular pressure distribution.
4. The lateral subgrade modulus values are provided for static and cyclic loading conditions. An appropriate loading condition should be selected for analysis.
5. Submerged unit weight.

Construction Considerations – Drilled Straight shafts

The drilling contractor should be experienced in the subsurface conditions observed at the site, and the excavations should be performed with equipment capable of providing a clean bearing area. The drilled straight-shaft foundation should be installed in general accordance with the procedures presented in "Drilled Shafts: Construction Procedures and LRFD Design Methods," by Brown, D.A., Turner, J.P., and Castelli, R.J., FHA Publication No. FHWA-NHI-10-016, 2010 and "Standard Specification for the Construction of Drilled Piers", ACI Publication No. 336.1-01, 2001.

The successful completion of the drilled straight-shaft will depend to a large extent on the suitability of the equipment and the operator's skills. The operation sequence should be scheduled so that the shaft excavation can be completed, reinforcing steel placed, and the concrete poured in a continuous, rapid, and orderly manner to minimize the time the excavation is open. Concrete should be placed as soon as practical and in all instances should be placed within the same day in order to use the side friction values recommended in this letter report.

Based on the subsurface conditions observed, the installation of drilled straight shafts will likely require the use of the Slurry Displacement Method and/or temporary steel casing due to the presence of sandier/siltier zones and groundwater. If drilled shaft installation is attempted without utilizing Slurry Displacement Method or temporary casing, zones of sloughing soils and/or groundwater inflow may occur during construction. Therefore, we recommend that provisions be incorporated into the plans and specifications to utilize slurry or casing to control sloughing and/or groundwater seepage during shaft construction.

The need for casing or slurry will depend on the depth of the drilled shaft and the groundwater conditions at the time of construction. If casing is used and seepage persists, the water accumulating in the foundation excavation should be pumped out. The condition of the bearing surface should be evaluated immediately prior to placing concrete, if casing is used in lieu of slurry. If groundwater inflow is too severe to be controlled by the use of casing and pumping or significant sloughing of the sidewalls occurs, the slurry method of construction should be utilized to complete the foundation installation.

Where casing is used, removal of the casing should be performed with extreme care and under proper supervision to minimize mixing of the surrounding soil and water with the fresh concrete. Rapid withdrawal of the casing may develop a suction that could cause the soil and water to flow into the excavation. An insufficient head of concrete in the casing during withdrawal could also allow the water to intrude into the wet concrete. Under no circumstances should loose soil be placed in the annulus between the casing and the drilled shaft sidewalls. The casing must be removed in order to utilize the skin friction values previously provided.

During slurry displacement, the foundation excavation is filled with a slurry mixture. The level of slurry should be maintained above the groundwater level to maintain a positive head in the foundation excavation. Therefore, the slurry tends to seep out of the excavation, rather than the groundwater seeping into the open excavation. The slurry must be maintained in the foundation excavation until design termination depth is achieved and should be removed only as concreting proceeds. The properties of the slurry including the density, viscosity, and pH must be carefully controlled and should be in accordance with Item 416 of Texas Department of Transportation (TXDOT) Standard Specifications for Construction of Highways, Streets, and Bridges.

Slurry left in place for long periods of time will build up on the sides of the shaft causing a reduction in skin friction.

The following procedures and equipment are recommended for installation of drilled shafts by the Slurry Displacement Method:

- The bottom of the drilled straight-shaft should be cleaned as well as practical just prior to concreting to remove cuttings.

- The concrete should be placed by means of a tremie with a one-way valve to prevent slurry from entering the pipe. The tremie should extend to the bottom of the drilled shaft to allow displacement of the slurry during concrete placement.
- During concrete placement, the end of the tremie should remain several feet within the concrete mass to reduce the entrapment of slurry. A tremie embedment of 5 to 10 feet is generally considered acceptable.
- The concrete should be relatively fluid to reduce the entrapment of slurry. We recommend that concrete with a slump of 6 to 8 inches be used.
- The upper few feet of concrete should be expunged from the shaft excavation if found to be contaminated with slurry or soil.

A surface casing may be required in addition to the slurry for shaft installation at this site if sloughing of near surface soils occurs. Where casing is used, removal of the casing should be performed with extreme care as previously discussed in this section.

Production shaft installation should be observed by a qualified technician experienced in drilled shaft installation techniques. At a minimum, the technician should observe shaft excavation, note any unusual installation occurrences, observe slurry properties and/or casing installation and removal, observe concrete placement and generally evaluate if shaft installation is being performed in accordance with project specifications.

Foundation Construction Monitoring

The performance of the foundation systems for the proposed structures will be highly dependent upon the quality of construction. Thus, we recommend that fill pad compaction and foundation installation be observed full time by an experienced Terracon soil technician under the direction of our geotechnical engineer. During foundation installation, the base of the foundations should be observed to evaluate the condition of the subgrade. We would be pleased to develop a plan for compaction and foundation installation observation to be incorporated in the overall quality control program.

Connection of Building Addition to Existing Building

Based on the information provided to us, we understand that the new building additions are planned to be built immediately adjacent and connected to the existing building. Due to the independence of the existing and proposed foundations systems, differential movements may occur between the foundation systems. The magnitude of the differential movement will be primarily dependent upon the stability of the moisture content of the near-surface soils, the quality of foundation construction and subgrade preparation utilized for the building additions, and the performance of the foundation system of the existing structure. Therefore, any members or connections of the new building additions which are common to the adjacent existing structure should be designed such that they are tolerant to differential movements whenever possible.

Floor Slabs

Planned finished grades for the proposed structures were not available at the time of this report. The anticipated finished floor elevation of the proposed structures is shown below.

| Proposed Structure | Anticipated Finished Floor Elevation |
|--------------------|---|
| Building Addition | Within about one foot and to match the finished floor elevation of the existing building. |
| Storage Building | Within about one to two feet above existing grade. |
| Tennis Courts | Within about one to two feet above existing grade. |

If the grading is planned to be altered from what has been previously described, Terracon should be notified to review and/or modify our recommendations given in this subsection.

The near surface soils observed within the area of the proposed building and building additions generally exhibited a low to medium expansion potential. Based on the information developed from our field and laboratory programs and on method TEX-124-E in the Texas Department of Transportation (TxDOT) Manual of Testing Procedures, we estimate that the subgrade soils at this site exhibit a Potential Vertical Rise (PVR) of up to approximately one inch.

To provide uniform support to the floor slabs, we recommend that a minimum 12 inches of properly placed and compacted select fill material be constructed immediately beneath the floor slabs. The building pad should extend a minimum of 3 feet beyond the edge of the proposed structure areas. The final exterior grade adjacent to the structures should be sloped to promote effective drainage away from the structure.

Select fill should be utilized for all grade adjustments within the structure areas. The subgrade and select fill soils should be prepared as outlined in the [Earthwork](#) section of this report, which contains material and placement requirements for select fill, as well as other subgrade preparation recommendations.

Pavements

Once the subgrade is properly prepared, a rigid pavement system may be considered for this project. Detailed traffic loads and frequencies were not available. However, we anticipate that traffic will consist primarily of passenger vehicles in the parking areas and passenger vehicles combined with garbage trucks and large multi-axle delivery trucks from time-to-time in driveway areas.

Tabulated in the following table are the assumed traffic frequencies and loads used to design pavement sections for this project. When actual traffic conditions have been

determined Terracon should be contacted to review the information to consider a need for revision of the pavement designs and related recommendations.

| Pavement Area | Traffic Design Index ¹ | Description |
|---|-----------------------------------|--|
| Automobile Parking Areas | DI-1 | Light traffic (Few vehicles heavier than passenger cars, no regular use by heavily loaded two axle trucks/buses.) (EAL ² < 6) |
| Driveways (Light Duty) | DI-2 | Medium to light traffic (Similar to DI-1 including not over 50 loaded two axle trucks/buses or lightly loaded larger vehicles per day. No regular use by heavily loaded trucks with three or more axles.) (EAL = 6-20) |
| Driveways and Truck Traffic Areas (Medium Duty) | DI-3 | Medium traffic (Including not over 300 heavily loaded two axle trucks/buses plus lightly loaded trucks with three or more axles and no more than 30 heavily loaded trucks with more than three axles per day.) (EAL = 21-75) |

1. Based on NSSGA traffic design indices.
2. Equivalent daily 18-kip single-axle load applications.

The top 6 inches of the finished subgrade soils directly beneath the pavements should be chemically treated with lime or a mixture of lime-flyash. The decision about the type and proper amount of additive should be made after the subgrade is open for inspection. Chemical treatment will increase the supporting value of the subgrade and decrease the effect of moisture on subgrade soils. These 6 inches of treatment is a required part of the pavement design and is not a part of the site and subgrade preparation for wet/soft subgrade conditions.

Listed below are pavement component thicknesses, which may be used as a guide for rigid pavement system at the site for the traffic classifications stated herein. These systems were derived based on general characterization of the subgrade. Specific testing (such as CBR's, resilient modulus tests, etc.) was not performed for this project to evaluate the support characteristics of the subgrade.

| Rigid Pavement System | | | |
|------------------------------|-----------------------------------|-------------|-------------|
| Component | Material Thickness, Inches | | |
| | DI-1 | DI-2 | DI-3 |
| Reinforced concrete | 5.0 | 6.0 | 7.0 |
| Treated subgrade | 6.0 | 6.0 | 6.0 |

Waste dumpster areas should be constructed of at least 7 inches of reinforced concrete pavement. The concrete pad areas should be designed so that the vehicle wheels of the collection truck are supported on the concrete while the dumpster is being lifted to support the large wheel loading imposed during waste collection.

Presented below are our recommended material requirements for the concrete pavement sections.

Reinforced Concrete Pavement – The materials and properties of reinforced concrete pavement should meet applicable requirements in the ACI Manual of Concrete Practice. The portland cement concrete mix should have a minimum 28-day compressive strength of 3,500 psi.

If river gravel is planned to be utilized in the portland cement concrete mix, Terracon should be contacted for additional services. The presence of river gravel in the portland cement concrete mix can result in excessive cracking and distress to the concrete pavement as a result of differing thermal expansion properties between the river gravel and cement paste. Special care should be taken in developing the project’s portland cement concrete mix design, joint layout, and placement to help reduce the potential for excessive cracking and distress if river gravel is planned to be utilized for the project.

Reinforcing Steel – ACI recommendations indicate that distributed steel reinforcement is not necessary when the pavement is properly jointed to form short panel lengths that will help reduce intermediate cracking. Provided the concrete pavement is designed and constructed as stated herein, the installation of reinforcing steel is optional and should be evaluated by the design team. Proper layout and installation of the joints within the pavement is critical to help control intermediate cracking.

If reinforcing steel is planned to be utilized in the concrete pavement by the design team, the following amount of reinforcing steel should be used as a guideline:

DI-1: #3 bars spaced at 18 inches or #4 bars spaced at 24 inches on centers in both directions.

DI-2: #3 bars spaced at 12 inches or #4 bars spaced at 18 inches on centers in both directions.

DI-3: #4 bars spaced at 18 inches on centers in both directions.

Control Joint Spacing – ACI recommendations indicate that control joints should be spaced at a maximum spacing of 30 times the thickness of the pavement for unreinforced parking lot pavements. Furthermore, ACI recommends a maximum control joint spacing of 12.5 feet for 5-inch pavements and a maximum control joint spacing of 15 feet for 6-inch or thicker pavements. Sawcut control joints should be cut within 4 to 12 hours of concrete placement to help control the formation of plastic shrinkage cracks as the concrete cures. The depth of the joint should be at least one-quarter of the slab depth when using a conventional saw or one inch when using early entry saws. The width of the cut should be in accordance with the joint sealant manufacturer recommendations.

Expansion Joint Spacing – ACI recommendations indicate that regularly spaced expansion joints may be deleted from concrete pavements. Therefore, the installation of expansion joints is optional and should be evaluated by the design team.

Construction Joints – When concrete is planned to be placed at different times, we recommend the use of a construction joint between paving areas. The construction joint should consist of a butt joint (not a keyway joint).

Concrete Curing Compound – A concrete curing compound, such as a Type 2 membrane curing compound conforming to TxDOT DMS-4650, “Hydraulic Cement Concrete Curing Materials and Evaporation Retardants” or equivalent, should be applied to the concrete surface immediately after placement of the concrete in accordance with TxDOT 2014 Standard Specifications Item 360.

Dowels at Expansion/Construction Joints – The smooth dowels at expansion/construction joints should be spaced at 12-inch centers and consist of the following:

DI-1: 5/8-inch diameter, 12-inches long with 5-inch embedment.

DI-2: 3/4-inch diameter, 14-inches long with 6-inch embedment.

DI-3: 7/8-inch diameter, 14-inches long with 6-inch embedment.

One end of the dowels should either be greased or sleeved to allow for lateral movement to occur.

Lime-Flyash Treated Subgrade – The low to medium plasticity clay soils (PI<15) should be treated with lime-flyash in accordance with TxDOT 2014 Standard Specifications Item 265. Based on the classification test results, we recommend about 2 to 3 percent lime and 7 to 8 percent flyash by dry weight be used for estimating and planning. The percentages are given as application by dry weight and are typically equivalent to about 10 to 15 pounds of lime and 35 to 40 pounds of flyash per square yard per 6-inch depth. Lime-flyash is also available pre-mixed, typically in percentages of 20 to 30 percent lime and

70 to 80 percent flyash. These pre-mixed products may be used if preferred at a rate of 50 pounds per square yard per 6-inch depth. The actual quantity of lime-flyash should be determined at the time of construction based on laboratory testing conducted using bulk samples of the subgrade soils. The subgrade should be compacted to at least 95 percent of the Standard Effort (ASTM D 698) maximum dry density at a moisture content within 2 percent of the optimum moisture content.

Lime Treated Subgrade – The medium plasticity clay soils ($PI \geq 15$) should be treated with lime in accordance with the TXDOT 2014 Standard Specifications Item 260. The amount of lime should be determined for subgrade soils by conducting laboratory tests just prior to construction. Based on the classification test results, we recommend that about 5 to 7 percent lime by dry weight be used for estimating and planning. The percentages are given as application by dry weight and are typically equivalent to about 25 to 35 pounds of lime per square yard per 6-inch depth. The actual quantity of lime should be determined at the time of construction based on lime determination tests conducted using bulk samples of the subgrade soils. The pulverization, mixing and curing of the lime treated subgrade is of particular importance in these clays. The subgrade should be compacted to a minimum of 95 percent of the Standard Effort (ASTM D 698) maximum dry density at a moisture content between optimum and 4 percent wet of the optimum moisture content.

Preferably, traffic should be kept off the treated subgrade for 7 days to facilitate curing of the soil-chemical mixture. In addition, the subgrade is not suitable for heavy construction traffic prior to paving.

Post-construction subgrade movements and some cracking of pavements are not uncommon for clay subgrade conditions such as those observed at this site. Although chemical treatment will help to reduce such movement/cracking, this movement/cracking cannot be feasibly eliminated.

Related civil design factors such as subgrade drainage, shoulder support, cross-sectional configurations, surface elevations and environmental factors which will significantly affect the service life must be included in the preparation of the construction drawings and specifications. Normal periodic maintenance will be required.

Long-term pavement performance will be dependent upon several factors, including maintaining subgrade moisture levels and providing for preventative maintenance. The following recommendations should be implemented to help promote long-term pavement performance:

- The subgrade and the pavement surface should be designed to promote proper surface drainage, preferably at a minimum grade of 2 percent;
- Install joint sealant and seal cracks immediately;
- Extend curbs into the treated subgrade for a depth of at least 4 inches to help reduce moisture migration into the subgrade soils beneath the pavement section; and

- Place compacted, low permeability clayey backfill against the exterior side of the curb and gutter.

Preventative maintenance should be planned and provided for the pavements at this site. Preventative maintenance activities are intended to slow the rate of pavement deterioration, and consist of both localized maintenance (e.g. crack and joint sealing and patching) and global maintenance (e.g. surface sealing). Prior to implementing any maintenance, additional engineering observations are recommended to determine the type and extent of preventative maintenance.

General Comments

Our work is conducted with the understanding of the project as described in the proposal and incorporates collaboration with the design team as we completed our services to verify assumptions. Revision of our understanding to reflect actual conditions important to our work was based on these verifications and it is reflected in this report. The design team should collaborate with Terracon to confirm these assumptions and to prepare the final design plans and specifications. This facilitates the incorporation of our opinions related to implementation of our geotechnical recommendations. Any information conveyed prior to the final report is for informational purposes only and should not be considered or used for decision-making purposes.

Our analysis and opinions are based upon our understanding of the geotechnical conditions in the area, the data obtained from our site exploration and from our understanding of the project. Variations will occur between exploration point locations, across the site, or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. Terracon should be retained as the Geotechnical Engineer, where noted in the final report, to provide observation and testing services during grading, excavation, foundation construction and other earth-related construction phases of the project. If variations appear, we can provide further evaluation and supplemental recommendations. If variations are noted in the absence of our observation and testing services on-site, we should be immediately notified so that we can provide evaluation and supplemental recommendations.

Our Scope of Services does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other services should be undertaken.

Our services and any correspondence are intended for the sole benefit and exclusive use of our client for specific application to the project discussed and are accomplished in accordance with generally accepted geotechnical engineering practices with no third party

Geotechnical Engineering Report

CFISD Cypress Ridge High School Additions | Houston, Texas
September 30, 2024 | Terracon Project No. 92245375



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Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly impact excavation cost. Any parties charged with estimating excavation costs should seek their own site characterization for specific purposes to obtain the specific level of detail necessary for costing.

Geotechnical Engineering Report

CFISD Cypress Ridge High School Additions | Houston, Texas
September 30, 2024 | Terracon Project No. 92245375

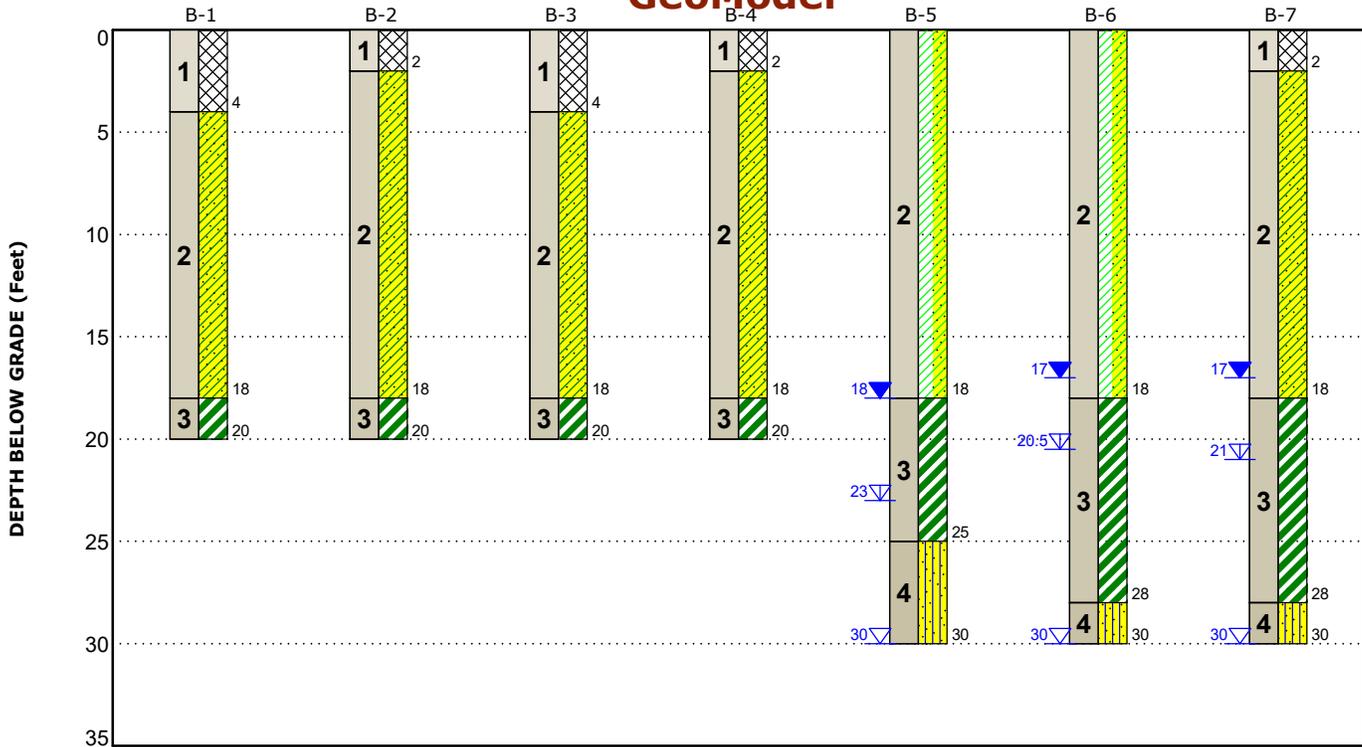


Figures

Contents:

GeoModel

GeoModel



This is not a cross section. This is intended to display the Geotechnical Model only. See individual logs for more detailed conditions.

| Model Layer | Layer Name | General Description | Legend | |
|-------------|--------------------------------------|--|------------|---------------------|
| 1 | Fill: Sandy Lean Clay | dark gray and tan, with calcareous nodules, sand pockets, and scattered roots | Fill | Sandy Lean Clay |
| 2 | Sandy Lean Clay and Lean Clay | dark gray, light gray, and tan, medium stiff to very stiff, with calcareous nodules and ferrous stains | Fat Clay | Lean Clay with Sand |
| 3 | Fat Clay | dark gray, light gray, reddish brown, and tan, very stiff, with sand pockets | Silty Sand | |
| 4 | Silty Sand | light gray, dense to very dense | | |

- First Water Observation
- Second Water Observation
- Third Water Observation

Groundwater levels are temporal. The levels shown are representative of the date and time of our exploration. Significant changes are possible over time.

Water levels shown are as measured during and/or after drilling. In some cases, boring advancement methods mask the presence/absence of groundwater. See individual logs for details.

NOTES:

Layering shown on this figure has been developed by the geotechnical engineer for purposes of modeling the subsurface conditions as required for the subsequent geotechnical engineering for this project. Numbers adjacent to soil column indicate depth below ground surface.

Geotechnical Engineering Report

CFISD Cypress Ridge High School Additions | Houston, Texas
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Attachments

Exploration and Testing Procedures

Field Exploration

| Number of Borings | Approximate Boring Depth (feet) ¹ | Location |
|---------------------|--|--|
| 3 (B-1 through B-3) | 20 | Proposed building addition areas |
| 1 (B-4) | 20 | Proposed athletics storage building area |
| 3 (B-5 through B-7) | 30 | Proposed tennis court and light pole areas |

1. Below existing grade.

Boring Layout and Elevations: We used handheld Global Positioning System (GPS) equipment to locate the approximate latitude and longitude of the borings with an accuracy of +/-25 feet. The boring depths were measured from the existing ground surface at the time of our field activities.

Subsurface Exploration Procedures: We advanced soil borings with a standard truck-mounted drill rig using solid stem continuous flight augers. Samples were obtained at 2-foot intervals in the upper 12 feet of each boring and at intervals of 5 feet thereafter. Soil sampling was typically performed using open-tube and/or split-barrel sampling procedures.

Cohesive soil samples were generally recovered using open-tube samplers. Hand penetrometer tests were performed on samples of cohesive soils in the field to serve as a general measure of consistency.

Granular soils and soils for which good quality open-tube samples could not be recovered were sampled by means of the Standard Penetration Test (SPT). This test consists of measuring the number of blows (N) required for a 140-pound hammer free falling 30 inches to drive a standard split-spoon sampler 12 inches into the subsurface material after being seated six inches. This blow count or SPT "N" value is used to evaluate the stratum. An automatic SPT hammer was used in advancing the split-spoon sampler at the borings. A greater efficiency is typically achieved with the automatic hammer compared to the conventional safety hammer operated with a cathead and rope. Published correlations between the SPT N-values and soil properties are based on the lower efficiency cathead and rope method. The higher efficiency of an automatic SPT hammer affects the SPT N-value by increasing the penetration per hammer blow over what would be obtained using the cathead and rope method.

The samples were placed in appropriate containers, taken to our soil laboratory for testing, and classified by a geotechnical engineer. In addition, we observed and recorded groundwater levels during drilling and sampling.

Our exploration team prepared field boring logs as part of standard drilling operations including sampling depths, penetration distances, and other relevant sampling information. Field logs include visual classifications of materials observed during drilling, and our interpretation of subsurface conditions between samples. Final boring logs, prepared from field logs, represent an interpretation of the field logs by a geotechnical engineer and include modifications based on laboratory observation and tests on select samples.

Property Disturbance: We backfilled the borings with auger cuttings upon completion. Excess auger cuttings were dispersed in the general vicinity of the boring. Our services do not include repair of the site beyond backfilling our borings. Because backfill material often settles below the surface after a period, we recommend borings be periodically checked and backfilled, if necessary. We can provide this service for additional fees at your request.

Laboratory Testing

The project engineer reviewed the field data and assigned laboratory tests to understand the engineering properties of the various soil strata, as necessary, for this project. Procedural standards noted below are for reference to methodology in general. In some cases, variations to methods were applied because of local practice or professional judgment. Standards noted below include reference to other, related standards. Such references are not necessarily applicable to describe the specific test performed.

- ASTM D2216 Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
- ASTM D7263 Standard Test Methods for Laboratory Determination of Density (Unit Weight) of Soil Specimens
- ASTM D4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
- ASTM D1140 Standard Test Method for Determining the Amount of Materials Finer than No. 200 Sieve in Soils by Washing
- ASTM D7928 Standard Test Method for Particle-Size Distribution (Gradation) of Fine-Grained Soils Using the Sedimentation Analysis
- ASTM D2166/D2166M Standard Test Method for Unconfined Compressive Strength of Cohesive Soil

The laboratory testing program included observation of soil samples by an engineer. Based on the results of our field and laboratory programs, we described and classified the soil samples in accordance with the Unified Soil Classification System (USCS).

Geotechnical Engineering Report

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Samples not tested in the laboratory will be stored for a period of 30 days subsequent to submittal of this report and will be discarded after this period, unless we are notified otherwise.

Geotechnical Engineering Report

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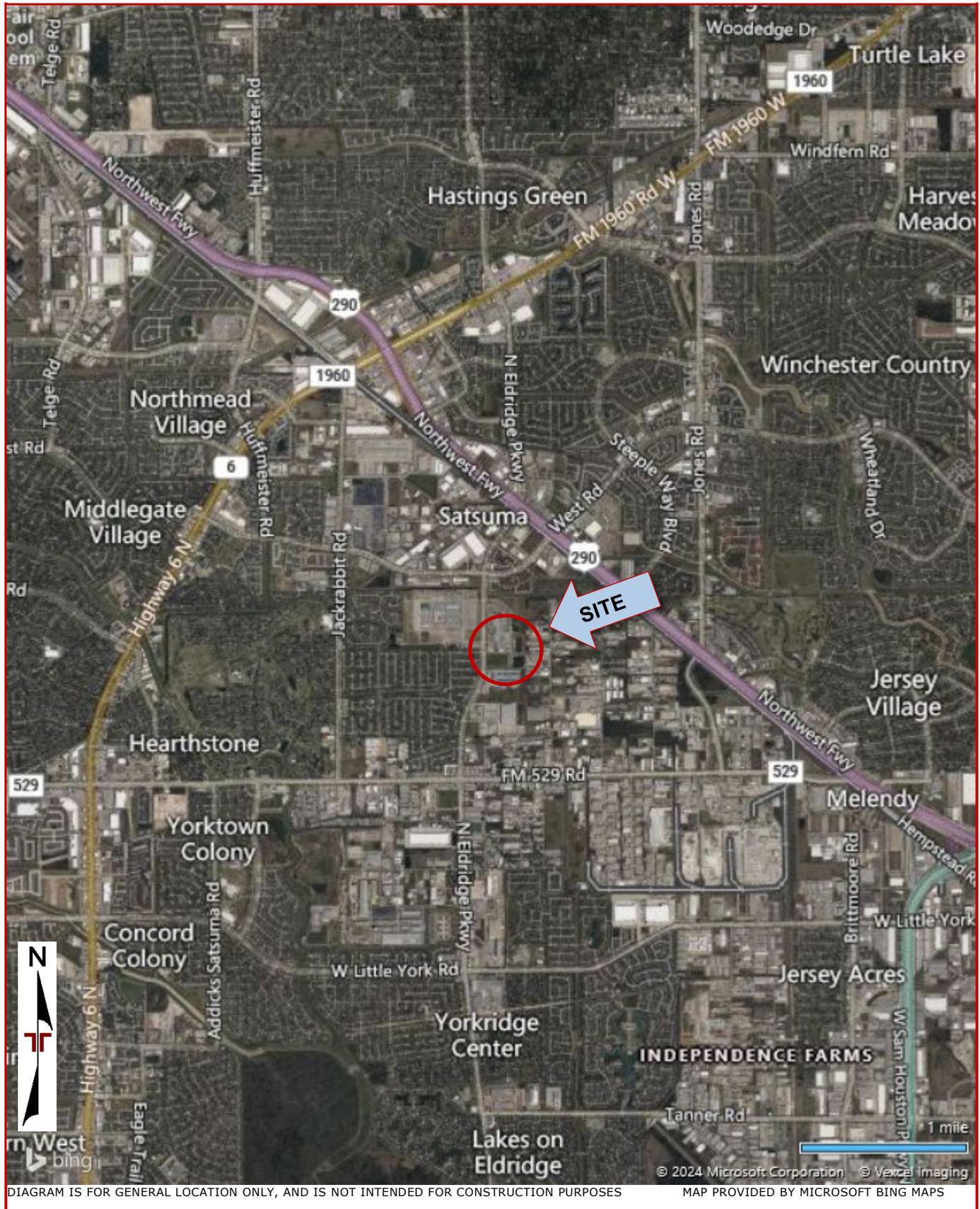
Site Location and Exploration Plans

Contents:

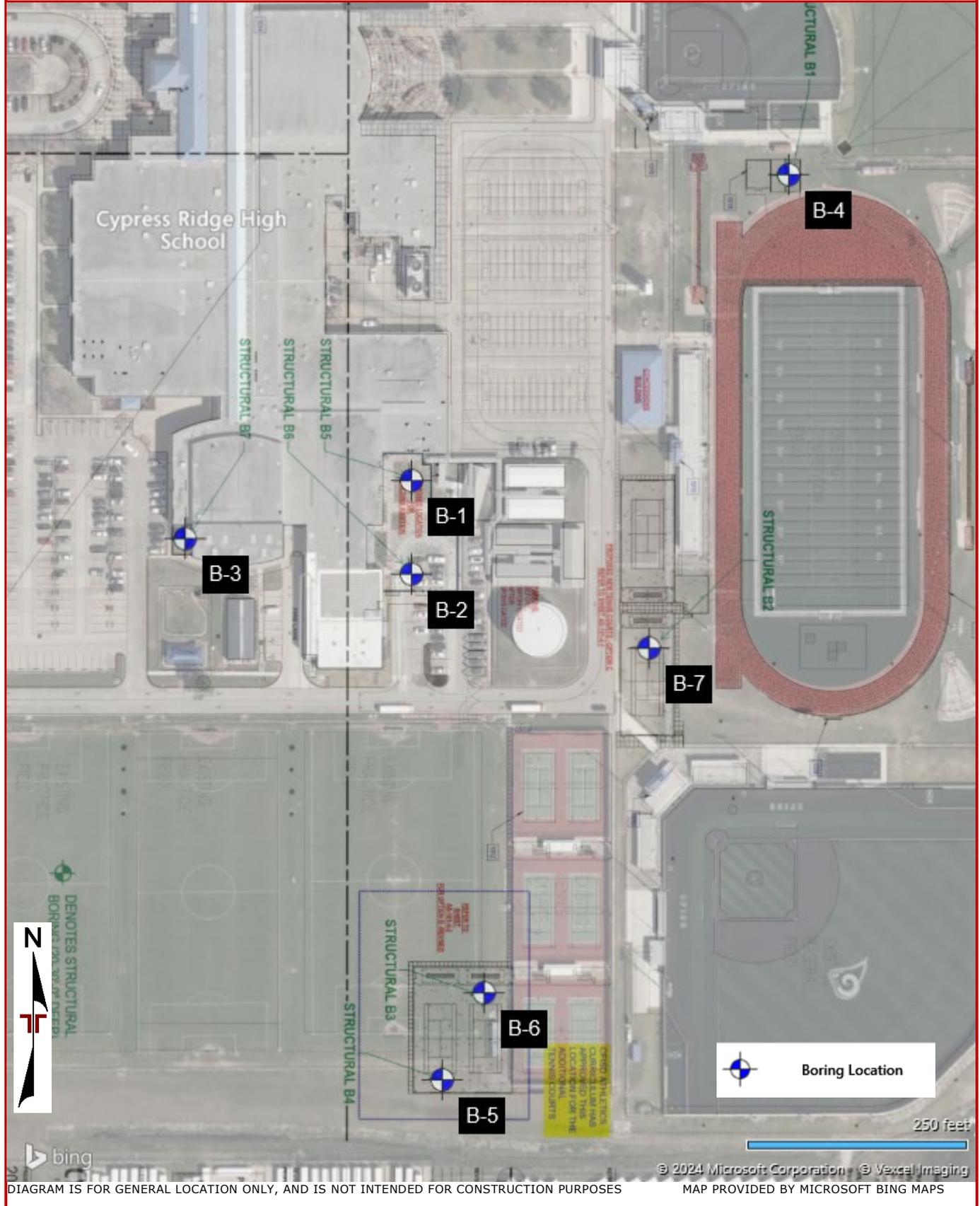
Site Location Plan
Exploration Plan

Note: All attachments are one page unless noted above.

Site Location



Exploration Plan



Exploration and Laboratory Results

Contents:

Boring Logs (B-1 through B-7)

Note: All attachments are one page unless noted above.

Boring Log No. B-1

| Model Layer | Graphic Log | Location: See Exploration Plan Latitude: 29.8912° Longitude: -95.6042° Depth (Ft.) | Depth (Ft.) | Water Level Observations | Sample Type | Field Test Results | Strength Test | | | Water Content (%) | Dry Unit Weight (pcf) | Atterberg Limits LL-PL-PI | Percent Fines |
|-------------|-------------|--|-------------|--------------------------|-------------|--------------------|---------------|----------------------------|------------|-------------------|-----------------------|------------------------------|---------------|
| | | | | | | | Test Type | Compressive Strength (tsf) | Strain (%) | | | | |
| 1 | | FILL - SANDY LEAN CLAY (CL) , dark gray, with calcareous nodules - with scattered roots 0 to 2 feet | 4.0 | | | 4.5 (HP) | | | | 7.4 | | 35-15-20 | |
| | | | 4.0 | | | 4.5 (HP) | | | | | | | |
| 2 | | SANDY LEAN CLAY (CL) , dark gray, stiff to very stiff, with calcareous nodules - light gray and tan 6 to 18 feet | 5 | | | 2.0 (HP) | | | | 17.9 | | 36-16-20 | |
| | | | 6 | | | 1.5 (HP) | | | | | | | |
| | | | 10 | | | 2.5 (HP) | UC | 1.37 | 6.4 | 16.0 | 118 | | 68 |
| | | | 15 | | | 3.5 (HP) | | | | | | | |
| 3 | | FAT CLAY (CH) , dark gray and tan, very stiff, with sand pockets | 18.0 | | | 3.5 (HP) | | | | | | | |
| | | | 20.0 | | | 4.5 (HP) | | | | | | | |
| | | Boring Terminated at 20 Feet | 20 | | | | | | | | | | |

| | | |
|---|---|---|
| <p>See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any). See Supporting Information for explanation of symbols and abbreviations.</p> | <p>Water Level Observations No free water observed.</p> | <p>Drill Rig Truck</p> |
| <p>Notes</p> | <p>Advancement Method Dry augered to 20 feet.</p> <p>Abandonment Method Boring backfilled with soil cuttings upon completion.</p> | <p>Driller DAS</p> <p>Logged by J. Grimes</p> <p>Boring Started 08-16-2024</p> <p>Boring Completed 08-16-2024</p> |

Boring Log No. B-2

| Model Layer | Graphic Log | Location: See Exploration Plan Latitude: 29.8909° Longitude: -95.6042° Depth (Ft.) | Depth (Ft.) | Water Level Observations | Sample Type | Field Test Results | Strength Test | | | Water Content (%) | Dry Unit Weight (pcf) | Atterberg Limits LL-PL-PI | Percent Fines |
|-------------|-------------|--|--------------|--------------------------|-------------|--------------------|---------------|----------------------------|------------|-------------------|-----------------------|------------------------------|---------------|
| | | | | | | | Test Type | Compressive Strength (tsf) | Strain (%) | | | | |
| 1 | | FILL - SANDY LEAN CLAY (CL) , dark gray, with calcareous nodules and scattered roots | 2.0 | | | 4.5 (HP) | | | | | | | |
| 2 | | SANDY LEAN CLAY (CL) , light gray and tan, very stiff, with calcareous nodules | 5 | | | 3.5 (HP) | | | 11.7 | | 25-15-10 | | |
| | | | 5 | | | 3.0 (HP) | | | | | | | |
| | | | 10 | | | 3.5 (HP) | | | 13.7 | | 40-15-25 | | |
| | | | 10 | | | 2.5 (HP) | | | | | | | |
| | | | 15 | | | 2.5 (HP) | UC | 2.27 | 11 | 16.6 | 111 | | |
| 3 | | FAT CLAY (CH) , light gray and tan, very stiff, with sand pockets | 18.0 20.0 | | | 4.5 (HP) | | | | | | | |
| | | Boring Terminated at 20 Feet | 20 | | | | | | | | | | |

| | |
|---|--|
| <p>See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any). See Supporting Information for explanation of symbols and abbreviations.</p> <p>Notes</p> | <p>Water Level Observations No free water observed.</p> <p>Drill Rig Truck</p> <p>Driller DAS</p> <p>Logged by J. Grimes</p> <p>Boring Started 08-16-2024</p> <p>Boring Completed 08-16-2024</p> |
| <p>Advancement Method Dry augered to 20 feet.</p> <p>Abandonment Method Boring backfilled with soil cuttings upon completion.</p> | |

Boring Log No. B-3

| Model Layer | Graphic Log | Location: See Exploration Plan Latitude: 29.8910° Longitude: -95.6050° Depth (Ft.) | Depth (Ft.) | Water Level Observations | Sample Type | Field Test Results | Strength Test | | | Water Content (%) | Dry Unit Weight (pcf) | Atterberg Limits LL-PL-PI | Percent Fines | |
|-------------|--------------------------|---|-------------|--------------------------|-------------|--------------------|---------------|----------------------------|------------|-------------------|-----------------------|------------------------------|---------------|--|
| | | | | | | | Test Type | Compressive Strength (tsf) | Strain (%) | | | | | |
| 1 | [Cross-hatch pattern] | FILL - SANDY LEAN CLAY (CL) , dark gray, with calcareous nodules - with scattered roots 0 to 2 feet | 4.0 | | | 4.5 (HP) | | | | 7.3 | | 27-15-12 | | |
| | | | | | | 1.5 (HP) | | | | | | | | |
| 2 | [Diagonal lines pattern] | SANDY LEAN CLAY (CL) , light gray and tan, stiff to very stiff, with calcareous nodules and ferrous stains | 5 | | | 2.5 (HP) | | | | 12.9 | | 28-15-13 | | |
| | | | | | | 3.0 (HP) | | | | | | | | |
| | | | 10 | | | 2.5 (HP) | UC | 2.11 | 7.1 | 16.0 | 123 | | | |
| | | | | | | 2.5 (HP) | | | | | | | | |
| | | | 15 | | | 3.5 (HP) | | | | | | | | |
| 3 | [Diagonal lines pattern] | FAT CLAY (CH) , light gray and tan, very stiff, with sand pockets | 18.0 | | | 4.5 (HP) | | | | | | | | |
| | | Boring Terminated at 20 Feet | 20.0 | | | | | | | | | | | |

| | | |
|---|---|---|
| <p>See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any). See Supporting Information for explanation of symbols and abbreviations.</p> | <p>Water Level Observations No free water observed.</p> | <p>Drill Rig Truck</p> |
| <p>Notes</p> | <p>Advancement Method Dry augered to 20 feet.</p> <p>Abandonment Method Boring backfilled with soil cuttings upon completion.</p> | <p>Driller DAS</p> <p>Logged by J. Grimes</p> <p>Boring Started 08-16-2024</p> <p>Boring Completed 08-16-2024</p> |

Boring Log No. B-4

| Model Layer | Graphic Log | Location: See Exploration Plan Latitude: 29.8922° Longitude: -95.6028° Depth (Ft.) | Depth (Ft.) | Water Level Observations | Sample Type | Field Test Results | Strength Test | | | Water Content (%) | Dry Unit Weight (pcf) | Atterberg Limits LL-PL-PI | Percent Fines |
|-------------|-------------|--|--------------|--------------------------|-------------|--------------------|---------------|----------------------------|------------|-------------------|-----------------------|------------------------------|---------------|
| | | | | | | | Test Type | Compressive Strength (tsf) | Strain (%) | | | | |
| 1 | | FILL - SANDY LEAN CLAY (CL) , dark gray, with calcareous nodules and scattered roots | 2.0 | | | 4.5 (HP) | | | | 7.6 | | 23-15-8 | |
| 2 | | SANDY LEAN CLAY (CL) , light gray and tan, stiff to very stiff, with calcareous nodules | 5 | | | 4.0 (HP) | | | | | | | |
| | | | 5 | | | 2.5 (HP) | | | 15.1 | | 27-15-12 | | |
| | | | 10 | | | 2.75 (HP) | | | | | | | |
| | | | 10 | | | 4.0 (HP) | UC | 1.64 | 4.7 | 10.9 | 129 | | 69 |
| | | | 15 | | | 4.0 (HP) | | | | | | | |
| 3 | | FAT CLAY (CH) , light gray and reddish brown, very stiff, with sand pockets | 18.0 20.0 | | | 2.0 (HP) | | | | | | | |
| | | Boring Terminated at 20 Feet | 20 | | | 4.0 (HP) | | | | | | | |

| | | |
|---|--|---|
| <p>See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any). See Supporting Information for explanation of symbols and abbreviations.</p> <p>Notes</p> | <p>Water Level Observations No free water observed.</p> <p>Advancement Method Dry augered to 20 feet.</p> <p>Abandonment Method Boring backfilled with soil cuttings upon completion.</p> | <p>Drill Rig Truck</p> <p>Driller DAS</p> <p>Logged by J. Grimes</p> <p>Boring Started 08-16-2024</p> <p>Boring Completed 08-16-2024</p> |
|---|--|---|

Boring Log No. B-5

| Model Layer | Graphic Log | Location: See Exploration Plan Latitude: 29.8894° Longitude: -95.6041° Depth (Ft.) | Depth (Ft.) | Water Level Observations | Sample Type | Field Test Results | Strength Test | | | Water Content (%) | Dry Unit Weight (pcf) | Atterberg Limits LL-PL-PI | Percent Fines |
|-------------|-------------|---|-------------|--------------------------|-------------|--------------------|---------------|----------------------------|------------|-------------------|-----------------------|------------------------------|---------------|
| | | | | | | | Test Type | Compressive Strength (tsf) | Strain (%) | | | | |
| 2 | | LEAN CLAY WITH SAND (CL) , dark gray, medium stiff to very stiff, with calcareous nodules - with scattered roots 0 to 2 feet - light gray and tan 2 to 18 feet - with ferrous stains 6 to 13 feet | 4.5 | | | 4.5 (HP) | | | | 7.3 | | 28-15-13 | |
| | | | 5 | | | 1.5 (HP) | UC | 0.79 | 12 | 16.9 | 112 | | 74 |
| | | | 10 | | 1.5 (HP) | | | 16.7 | 32-15-17 | | | | |
| | | | 15 | | 2.0 (HP) | UC | 2.19 | 15 | 16.2 | 116 | | | |
| | | | 20 | | 2.5 (HP) | | | | | | | | |
| | | | 25 | | 2.5 (HP) | | | | | | | | |
| 3 | | FAT CLAY (CH) , light gray and reddish brown, very stiff, with sand pockets | 18.0 | ▼ | | 4.0 (HP) | | | | | | | |
| | | | 25 | ▼ | | 4.5 (HP) | | | | | | | |
| 4 | | SILTY SAND (SM) , light gray, dense | 25.0 | | | | | | | | | | |
| | | | 30.0 | ▼ | X | 16-20-28 N=48 | | | | | | | |
| | | Boring Terminated at 30 Feet | 30 | | | | | | | | | | |

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (If any).
 See [Supporting Information](#) for explanation of symbols and abbreviations.

Notes
 Percent finer than 2 microns at 2 to 4 feet is 24%.

Water Level Observations
 ▼ While drilling
 ▼ After 5 minutes
 ▼ After 15 minutes

Advancement Method
 Dry augered to 30 feet.

Abandonment Method
 Boring backfilled with soil cuttings upon completion.

Drill Rig
 Truck

Hammer Type
 Automatic

Driller
 DAS

Logged by
 J. Grimes

Boring Started
 08-16-2024

Boring Completed
 08-16-2024

Boring Log No. B-6

| Model Layer | Graphic Log | Location: See Exploration Plan Latitude: 29.8896° Longitude: -95.6039° Depth (Ft.) | Depth (Ft.) | Water Level Observations | Sample Type | Field Test Results | Strength Test | | | Water Content (%) | Dry Unit Weight (pcf) | Atterberg Limits LL-PL-PI | Percent Fines |
|-------------|-------------|---|-------------|--------------------------|-------------|--------------------|---------------|----------------------------|------------|-------------------|-----------------------|------------------------------|---------------|
| | | | | | | | Test Type | Compressive Strength (tsf) | Strain (%) | | | | |
| 2 | | LEAN CLAY WITH SAND (CL) , dark gray, medium stiff to very stiff, with calcareous nodules - with scattered roots 0 to 2 feet - light gray and tan 2 to 18 feet | | | | 4.5 (HP) | | | | | | | |
| | | | | | | 2.25 (HP) | | | 13.9 | | 29-15-14 | | |
| | | | 5 | | | 2.0 (HP) | UC | 0.65 | 5.1 | 13.8 | 117 | | 71 |
| | | | | | | 4.0 (HP) | | | | 13.9 | | 40-15-25 | |
| | | | | | | 4.0 (HP) | | | | | | | |
| | | | 10 | | | 2.0 (HP) | UC | 1.41 | 13 | 17.1 | 114 | | |
| 3 | | FAT CLAY (CH) , light gray and reddish brown, very stiff, with sand pockets | | | | 2.5 (HP) | | | | | | | |
| | | | 18.0 | | | 4.5 (HP) | | | | | | | |
| | | | | | | 4.5 (HP) | | | | | | | |
| 20 | | | 4.5 (HP) | | | | | | | | | | |
| 4 | | SILTY SAND (SM) , light gray, very dense | | | | 20-24-29 N=53 | | | | | | | |
| | | | 28.0 | | | | | | | | | | |
| | | Boring Terminated at 30 Feet | 30.0 | | | | | | | | | | |

| | | |
|--|--|---|
| <p>See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any). See Supporting Information for explanation of symbols and abbreviations.</p> <p>Notes Percent finer than 2 microns at 4 to 6 feet is 25%.</p> | <p>Water Level Observations</p> <ul style="list-style-type: none"> ▽ While drilling ▽ After 5 minutes ▽ After 15 minutes <p>Advancement Method Dry augered to 30 feet.</p> <p>Abandonment Method Boring backfilled with soil cuttings upon completion.</p> | <p>Drill Rig Truck</p> <p>Hammer Type Automatic</p> <p>Driller DAS</p> <p>Logged by J. Grimes</p> <p>Boring Started 08-16-2024</p> <p>Boring Completed 08-16-2024</p> |
|--|--|---|

Boring Log No. B-7

| Model Layer | Graphic Log | Location: See Exploration Plan Latitude: 29.8907° Longitude: -95.6033° Depth (Ft.) | Depth (Ft.) | Water Level Observations | Sample Type | Field Test Results | Strength Test | | | Water Content (%) | Dry Unit Weight (pcf) | Atterberg Limits LL-PL-PI | Percent Fines | |
|-------------|-------------|--|-------------|--------------------------|-------------|--------------------|---------------|----------------------------|------------|-------------------|-----------------------|------------------------------|---------------|--|
| | | | | | | | Test Type | Compressive Strength (tsf) | Strain (%) | | | | | |
| 1 | | FILL - SANDY LEAN CLAY (CL) , dark gray, with calcareous nodules and scattered roots | 2.0 | | | 4.5 (HP) | | | | 14.9 | | 35-16-19 | | |
| 2 | | SANDY LEAN CLAY (CL) , light gray and tan, stiff to very stiff, with calcareous nodules | | | | 2.0 (HP) | UC | 1.29 | 4.8 | 15.1 | 117 | | | |
| | | | 5 | | | 3.5 (HP) | | | | 15.4 | | 37-15-22 | | |
| | | | | | | 3.5 (HP) | | | | | | | | |
| | | | 10 | | | 2.5 (HP) | UC | 1.03 | 5 | 16.1 | 118 | | | |
| | | | | | | 3.5 (HP) | | | | | | | | |
| 3 | | FAT CLAY (CH) , light gray and reddish brown, very stiff, with sand pockets | 18.0 | | | 4.5 (HP) | UC | 2.53 | 4.5 | 21.1 | 104 | | | |
| | | | 25 | | | 3.5 (HP) | | | | | | | | |
| 4 | | SILTY SAND (SM) , light gray, very dense | 28.0 | | | | | | | | | | | |
| | | Boring Terminated at 30 Feet | 30.0 | | | 21-24-34 N=58 | | | | | | | | |

| | | |
|---|--|---|
| <p>See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).</p> <p>See Supporting Information for explanation of symbols and abbreviations.</p> | <p>Water Level Observations</p> <ul style="list-style-type: none"> ▽ While drilling ▽ After 5 minutes ▽ After 15 minutes | <p>Drill Rig Truck</p> <p>Hammer Type Automatic</p> <p>Driller DAS</p> <p>Logged by J. Grimes</p> <p>Boring Started 08-16-2024</p> <p>Boring Completed 08-16-2024</p> |
| <p>Notes</p> | <p>Advancement Method Dry augered to 30 feet.</p> <p>Abandonment Method Boring backfilled with soil cuttings upon completion.</p> | |

Supporting Information

Contents:

General Notes

Unified Soil Classification System

Note: All attachments are one page unless noted above.

General Notes

| Sampling | Water Level | Field Tests |
|--|---|---|
| Shelby Tube Standard Penetration Test | Water Initially Encountered Water Level After a Specified Period of Time Water Level After a Specified Period of Time Cave In Encountered Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations. | N Standard Penetration Test Resistance (Blows/Ft.) (HP) Hand Penetrometer (T) Torvane (DCP) Dynamic Cone Penetrometer UC Unconfined Compressive Strength (PID) Photo-Ionization Detector (OVA) Organic Vapor Analyzer |

Descriptive Soil Classification

Soil classification as noted on the soil boring logs is based Unified Soil Classification System. Where sufficient laboratory data exist to classify the soils consistent with ASTM D2487 "Classification of Soils for Engineering Purposes" this procedure is used. ASTM D2488 "Description and Identification of Soils (Visual-Manual Procedure)" is also used to classify the soils, particularly where insufficient laboratory data exist to classify the soils in accordance with ASTM D2487. In addition to USCS classification, coarse grained soils are classified on the basis of their in-place relative density, and fine-grained soils are classified on the basis of their consistency. See "Strength Terms" table below for details. The ASTM standards noted above are for reference to methodology in general. In some cases, variations to methods are applied as a result of local practice or professional judgment.

Location And Elevation Notes

Exploration point locations as shown on the Exploration Plan and as noted on the soil boring logs in the form of Latitude and Longitude are approximate. See Exploration and Testing Procedures in the report for the methods used to locate the exploration points for this project. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

Strength Terms

| Relative Density of Coarse-Grained Soils <small>(More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance</small> | | Consistency of Fine-Grained Soils <small>(50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance</small> | | |
|---|---|---|--|---|
| Relative Density | Standard Penetration or N-Value (Blows/Ft.) | Consistency | Unconfined Compressive Strength Qu (tsf) | Standard Penetration or N-Value (Blows/Ft.) |
| Very Loose | 0 - 3 | Very Soft | less than 0.25 | 0 - 1 |
| Loose | 4 - 9 | Soft | 0.25 to 0.50 | 2 - 4 |
| Medium Dense | 10 - 29 | Medium Stiff | 0.50 to 1.00 | 4 - 8 |
| Dense | 30 - 50 | Stiff | 1.00 to 2.00 | 8 - 15 |
| Very Dense | > 50 | Very Stiff | 2.00 to 4.00 | 15 - 30 |
| | | Hard | > 4.00 | > 30 |

Relevance of Exploration and Laboratory Test Results

Exploration/field results and/or laboratory test data contained within this document are intended for application to the project as described in this document. Use of such exploration/field results and/or laboratory test data should not be used independently of this document.

Unified Soil Classification System

| Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests ^A | | | | Soil Classification | |
|--|---|--|---|---|--|
| | | | | Group Symbol | Group Name ^B |
| Coarse-Grained Soils: More than 50% retained on No. 200 sieve | Gravels: More than 50% of coarse fraction retained on No. 4 sieve | Clean Gravels: Less than 5% fines ^C | $Cu \geq 4$ and $1 \leq Cc \leq 3$ ^E | GW | Well-graded gravel ^F |
| | | Gravels with Fines: More than 12% fines ^C | $Cu < 4$ and/or $[Cc < 1$ or $Cc > 3.0]$ ^E | GP | Poorly graded gravel ^F |
| | | | Fines classify as ML or MH | GM | Silty gravel ^{F, G, H} |
| | | Sands: 50% or more of coarse fraction passes No. 4 sieve | Clean Sands: Less than 5% fines ^D | Fines classify as CL or CH | GC |
| | $Cu \geq 6$ and $1 \leq Cc \leq 3$ ^E | | | SW | Well-graded sand ^I |
| | Sands with Fines: More than 12% fines ^D | | $Cu < 6$ and/or $[Cc < 1$ or $Cc > 3.0]$ ^E | SP | Poorly graded sand ^I |
| | | | Fines classify as ML or MH | SM | Silty sand ^{G, H, I} |
| | Fine-Grained Soils: 50% or more passes the No. 200 sieve | Silts and Clays: Liquid limit less than 50 | Inorganic: | PI > 7 and plots above "A" line ^J | CL |
| PI < 4 or plots below "A" line ^J | | | | ML | Silt ^{K, L, M} |
| Organic: | | | $\frac{LL \text{ oven dried}}{LL \text{ not dried}} < 0.75$ | OL | Organic clay ^{K, L, M, N} Organic silt ^{K, L, M, O} |
| | | | Silts and Clays: Liquid limit 50 or more | Inorganic: | PI plots on or above "A" line |
| PI plots below "A" line | | MH | | | Elastic silt ^{K, L, M} |
| Organic: | | $\frac{LL \text{ oven dried}}{LL \text{ not dried}} < 0.75$ | | OH | Organic clay ^{K, L, M, P} Organic silt ^{K, L, M, Q} |
| | | Highly organic soils: | | Primarily organic matter, dark in color, and organic odor | |

^A Based on the material passing the 3-inch (75-mm) sieve.

^B If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

^C Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

^D Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay.

^E $Cu = D_{60}/D_{10}$ $Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$

^F If soil contains $\geq 15\%$ sand, add "with sand" to group name.

^G If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

^H If fines are organic, add "with organic fines" to group name.

^I If soil contains $\geq 15\%$ gravel, add "with gravel" to group name.

^J If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

^K If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

^L If soil contains $\geq 30\%$ plus No. 200 predominantly sand, add "sandy" to group name.

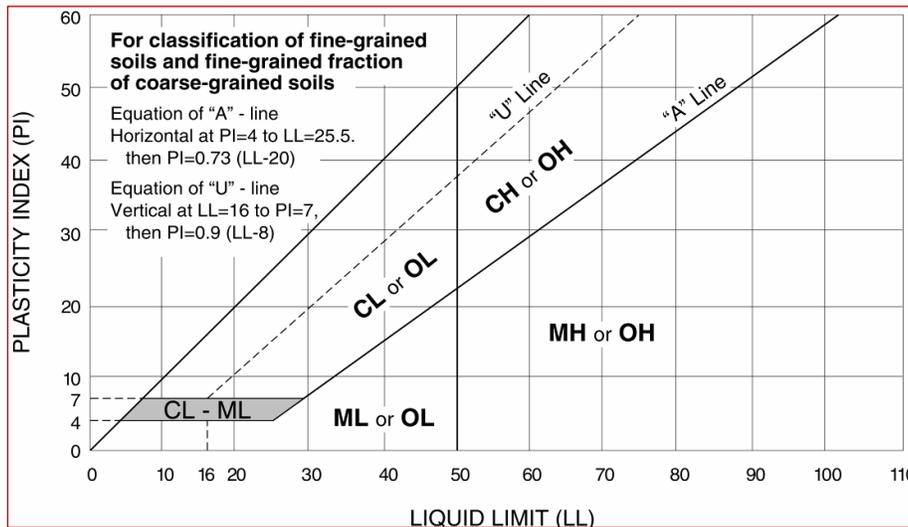
^M If soil contains $\geq 30\%$ plus No. 200, predominantly gravel, add "gravelly" to group name.

^N PI ≥ 4 and plots on or above "A" line.

^O PI < 4 or plots below "A" line.

^P PI plots on or above "A" line.

^Q PI plots below "A" line.



SECTION 02 41 00 - DEMOLITION

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Demolishing and removing existing pavement, structures, equipment, and materials as shown on the plans.
- B. Disposal of demolished materials and equipment.

1.2 UNIT PRICES

- A. Removing and disposing of asphalt or concrete pavement including curb, base and sub-base material shall be measured and paid for by the square yard without regard to thickness and the measurement shall include all labor and materials including breaking up the asphalt pavement, hauling, unloading, and disposal.
- B. Removing and disposing of concrete sidewalk and pavement including subgrade material shall be measured and paid for by the square foot without regard to thickness and the measurement shall include all labor and materials including breaking up the concrete pavement, hauling, unloading, and disposal.
- C. Sawed cuts shall be measured and paid for by the linear foot and the measurement shall include all equipment, labor and materials.
- D. Removing and disposing of storm sewer piping, manholes, and related appurtenances shall be measured and paid for by the unit specified in the bid form for the appropriate item and shall include all labor and materials for removal and disposal.

1.3 PAYMENT

- A. The work performed and materials furnished as prescribed by this item shall be paid for at the contract unit price bid for the following item:
 - Removal of Reinforced Concrete Pavement per S.Y.
- B. The removal of sidewalks shall be paid for as a component of the contract unit price bid for the following item:
 - Removal of Concrete Sidewalk per S.F.
- C. The work performed and materials furnished as prescribed by this item shall be paid for at the contract unit price bid for the following item:
 - Removal of Asphalt Pavement per S.Y.
- D. The removal of storm sewer piping, manholes, and related appurtenances shall be paid for at the contract unit price bid for the applicable item.
- E. The unit price bid for each item shall be full compensation for furnishing all equipment, labor, disposal fees, and materials needed to complete the work in accordance with the Contract Documents.

1.4 ENVIRONMENTAL CONTROLS

- A. Minimize spread of dust and flying particles. If required by governing regulations, use temporary enclosures and other suitable methods to prevent the spread of dust, dirt, and debris.
- B. Use appropriate controls to limit noise from demolition to acceptable levels.
- C. Do not use water where it can create dangerous or objectionable conditions, such as localized flooding, erosion, or sedimentation of nearby ditches or streams.
- D. Stop demolition and notify Engineer if underground fuel storage tanks, asbestos, PCB's, contaminated soils, or other hazardous materials are encountered.
- E. Remove equipment and materials not designated for reuse or salvage and all waste and debris resulting from demolition from site. Dispose of removed equipment, materials, waste, and debris in a manner conforming to applicable laws and regulations.

PART 2 PRODUCTS

2.1 EQUIPMENT AND MATERIALS FOR DEMOLITION

- A. Fires shall not be permitted.
- B. The use of a "drop hammer" shall not be permitted where the potential for damage to underground utilities exists.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Prior to demolition, make an inspection with Engineer to determine the condition of existing structures and features adjacent to items designated for demolition.
- B. Engineer will mark or list existing equipment to remain on the property of the Owner.
- C. Do not proceed with demolition or removal operations until after the joint inspection and subsequent authorization by Engineer.

3.2 PROTECTION OF PERSONS AND PROPERTY

- A. Provide safe working conditions for employees throughout demolition and removal operations. Observe all safety requirements for work below grade.
- B. Maintain safe access to adjacent property and buildings at all times. Do not obstruct roadways, sidewalks, or passageways adjacent to the work.
- C. Perform demolition in a manner to prevent damage to adjacent property. Repair damage to Owner's property or adjacent property and facilities.
- D. The Contractor shall be responsible for the safety and integrity of adjacent structures and shall be liable for any damage due to movement or settlement. Provide proper framing and shoring necessary for support. Cease operations if an adjacent structure appears to be endangered.

Resume demolition only after proper protective measures have been taken.

- E. Erect and maintain enclosures, barriers, warning lights, and other required protective devices.

3.3 UTILITY SERVICES

- A. Follow rules and regulations of authorities or utility companies having jurisdiction over water, natural gas, electricity, or telephone services.
- B. Notify and coordinate with utility company and adjacent building occupants when temporary interruption of utility service is necessary.

3.4 DISPOSAL

- A. Remove from the site all items contained in or upon the structure not designated for reuse or salvage.
- B. Follow method of disposal as required by regulatory agencies.

3.5 BACKFILL

- A. Backfill holes in accordance with specification sections governing materials indicated on Drawings. Where no material is indicated, backfill with approved borrow and compact to density of adjacent soil.
- B. Do not backfill with material from demolition unless approved by Engineer.

END OF SECTION

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SECTION 02 41 13.10 - REMOVING EXISTING PAVEMENT AND STRUCTURES

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Removing concrete paving, asphaltic concrete pavement, and base courses.
- B. Removing concrete curbs, concrete curbs and gutters, sidewalks, and driveways.
- C. Removing pipe culverts and sewers.
- D. Removing existing inlets and manholes.
- E. Removing miscellaneous structures of concrete or masonry.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices:
 - 1. Payment for removing and disposing of asphaltic surfacing and unreinforced concrete base under asphaltic surfacing, regardless of the thickness encountered, is on a square yard basis measured between lips of gutters.
 - 2. Payment for removing and disposing of concrete base under surfacing with curbs, regardless of the thickness encountered, is on a square yard basis measured from back-to-back of curbs. Payment includes removal of all concrete base, asphaltic surfacing, concrete pavement, esplanade curbs, curb and gutters, and paving headers.
 - 3. Payment for removing and disposing of reinforced concrete pavement, regardless of its thickness, is on a square yard basis measured from back-to-back of curbs. Payment includes concrete pavement, esplanade curbs, curbs and gutters, and paving headers.
 - 4. Payment for removing and disposing of monolithic curbs and gutters, and concrete curbs, is on a linear foot basis measured along the face of the curb.
 - 5. Payment for removing and disposing of cement stabilized shell base course, with or without asphaltic surfacing, is on a square yard basis.
 - 6. Payment for removing and disposing of concrete sidewalks is on a square yard basis.
 - 7. Payment for removing and disposing of concrete driveways is on a square yard basis.
 - 8. Payment for removing and disposing of miscellaneous concrete and masonry is on a cubic yard basis of the structure in place.
 - 9. Payment for removing and disposing of pipe culverts and sewers is on a linear foot basis for each diameter and each material type of pipe removed.
 - 10. Payment for removing and disposing of existing inlets is on a unit price basis for each inlet removed.
 - 11. Payment for removing and disposing of existing manholes is on a unit price basis for each manhole removed.
 - 12. Payment for saw cutting of existing pavement is on a linear foot basis.
 - 13. No payment will be made for work removed without the Engineer's approval or for pavements or structures removed for the Contractor's convenience.
- B. Stipulated Price (Lump Sum). If the Contract is a Stipulated Price Contract, payment for work in this Section is included in the total Stipulated Price.

1.3 REGULATORY REQUIREMENTS

- A. Conform to applicable codes for disposal of debris.
- B. Coordinate removal work with utility companies.

PART 2 PRODUCTS – Not Used

PART 3 EXECUTION

3.1 PREPARATION

- A. Obtain advance approval from Engineer for dimensions and limits of removal work.
- B. Identify known utilities below grade. Stake and flag locations.

3.2 PROTECTION

- A. Protect the following from damage or displacement:
 - 1. Adjacent public and private property.
 - 2. Trees, plants, and other landscape features designated to remain.
 - 3. Utilities designated to remain.
 - 4. Pavement and utility structures designated to remain.
 - 5. Bench marks, monuments, and existing structures designated to remain.

3.3 REMOVALS

- A. Remove pavements and structures by methods that will not damage underground utilities. Do not use a drop hammer near existing underground utilities.
- B. Minimize amount of earth loaded during removal operations.
- C. Where existing pavement is to remain, make straight saw cuts in existing pavement to provide clean breaks prior to removal. Do not break concrete pavement or base with drop hammer unless concrete or base has been saw cut to a minimum depth of two (2) inches.
- D. Where street and driveway saw cut locations coincide or fall within three (3) feet of existing construction or expansion joints, break out to existing joint.
- E. Remove sidewalks and curbs to nearest existing dummy, expansion, or construction joint.
- F. Where existing end of pipe culvert or end of sewer is to remain, install an 8-inch thick masonry plug in pipe end prior to backfill.

3.4 BACKFILL

- A. Backfill of removal areas shall be in accordance with requirements of Division 31.

3.5 DISPOSAL

- A. Inlet frames, grates, plates, and manhole frames and covers may remain property of the Owner. Disposal shall be in accordance with requirements of Section 01 74 19 – Construction Waste Management and Disposal.
- B. Remove from the site debris resulting from work under this section in accordance with requirements of Section 01 74 19 - Construction Waste Management and Disposal.

END OF SECTION

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SECTION 02 41 13.11 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Disposal of waste material and salvageable material.

1.2 SUBMITTALS

- A. Conform to requirements of Division 1.
- B. Contractor shall obtain all required permits prior to disposal of excess material in areas designated as being in "100-year Flood Hazard Area."
- C. Obtain and submit disposal permits for proposed disposal sites, if required by local ordinances.
- D. Submit copy of written permission from property owner, with description of property, prior to disposal of excess material adjacent to Project. Submit written and signed release from property owner upon completion of disposal work.
- E. Describe waste materials expected to be stored on-site and a description of controls to reduce Pollutants from these materials, including storage practices to minimize exposure of materials to storm water; and spill prevention and response measures in the Project's Storm Water Pollution Prevention Plan (SWPPP). Refer to Division 1.

PART 2 PRODUCTS -Not Used

PART 3 EXECUTION

3.1 SALVAGEABLE MATERIAL

- A. Excavated Material: When indicated on Drawings, load, haul, and deposit excavated material at location or locations shown on Drawings outside limits of Project.
- B. Base, Surface, and Bedding Material: Load shell, gravel, bituminous, or other base and surfacing material designated for salvage into Owner's designated trucks.
- C. Pipe Culvert: Load culverts designated for salvage into Owner's designated trucks.
- D. Other Salvageable Materials: Conform to requirements of individual Specification Sections.
- E. Coordinate loading of salvageable material on Owner's trucks with Owner's Representative.
- F. The Contractor shall dispose of all items the Owner refuses in conformance with the requirements of Division 1 at no additional cost to the Owner.

3.2 EXCESS MATERIAL

- A. Remove and legally dispose of vegetation, rubble, broken concrete, debris, asphaltic concrete pavement, excess soil, and other materials not designated for salvage from job site.
- B. Excess soil may be deposited on private property adjacent to Project when written permission is obtained from property owner. See Paragraph 1.02 D above.
- C. Verify flood plain status of any proposed disposal site. Do not dispose of excavated materials in area designated as within 100-year Flood Hazard Area unless a permit has been obtained. Remove excess material placed in "100-year Flood Hazard Area" without a permit, at no additional cost to the Owner.
- D. Remove waste materials from site daily, in order to maintain site in neat and orderly condition.

END OF SECTION

SECTION 02 41 19 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Demolition and removal of building features and equipment to allow for additional work.

1.2 DEFINITIONS

- A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.
- B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse.
- C. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.
- D. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.
- E. 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.

1.3 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.

1.4 SUBMITTALS

- A. Proposed Protection Measures: Submit informational report, including Drawings, that indicates the measures proposed for protecting individuals and property. Indicate proposed locations and construction of barriers.
- B. 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 and 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.
- C. Project Record Documents: Accurately record actual locations of capped and active utilities and concealed construction.

- D. Inventory: Submit a list of items to be removed and salvaged and deliver to Owner prior to start of demolition in addition to items indicated elsewhere.

1.5 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: 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.
- E. On-site storage or sale of removed items or materials is not permitted.

1.6 COORDINATION

- A. Arrange selective demolition schedule so as not to interfere with Owner's operations.

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 ASSE A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Review Project Record Documents of existing construction provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.
- B. Verify that hazardous materials have been remediated before proceeding with building demolition operations.
- C. 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.

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.
- 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. 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.
 - 2. 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.

3.3 PROTECTION

- A. Temporary Protection: Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction and as indicated.
 - 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 01 50 00 "Temporary Facilities and Controls."
- B. Remove temporary barriers and protections where hazards no longer exist. Where open excavations or other hazardous conditions remain, leave temporary barriers and protections in place.

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 portable fire-suppression devices during flame-cutting operations.
5. Maintain adequate ventilation when using cutting torches.
6. Dispose of demolished items and materials promptly.

B. 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.

C. 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 REPAIRS

- A. Promptly repair damage to adjacent construction caused by demolition operations.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove demolition waste materials from Project site in accordance with Section 01 73 00.
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.
- B. Do not burn demolished materials.
- C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

3.7 CLEANING

- A. Clean adjacent areas of dust, dirt, and debris caused by selective demolition operations and return to condition existing before selective demolition operations began.
1. Clean roadways of debris caused by debris transport.

END OF SECTION

SECTION 02 50 00 - SITE RESTORATION

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Restoration of site affected by the Work in public or private property, including pavement, esplanades, sidewalks, driveways, fences, lawns, and landscaping.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices.
 - 1. Payment for restoration of Project site disturbed by utility construction operations is on a linear foot basis. Measurement will be as provided for corresponding utility in each Specification section. No separate payment made for branch pipe, valves and, other associated work for utilities. Measurement for restoration with multiple utilities within the same right-of-way will be on a linear foot basis for only one utility.
 - 2. No separate payment made for facility or roadway projects. Include cost in the surface improvements associated with the facility or roadway construction.
 - 3. Payment includes required site restoration within the right-of-way or easement regardless of size or type of pipe, method of construction, paved or unpaved areas or thickness and width of pavement.
 - 4. No separate payment made for site restoration for service connections under this Section. Include cost in appropriate utility section.
 - 5. Refer to Division 1 for Unit Price procedures.
- B. Stipulated Price (Lump Sum) Contracts. If Contract is Stipulated Price Contract, include payment for work under this section in total Stipulated Price.

1.3 DEFINITIONS

- A. Phase: Locations identified on the plans and listed in Division 1.
- B. Site Restoration: Replacement or reconstruction of Site Improvements located in rights-of-way, easements, public property, and private property affected or altered by the Work.
- C. Site Improvement: Includes pavement, curbs and gutters, esplanades, sidewalks, driveways, fences, lawns, irrigation systems, landscaping, and other improvements in existence at the Project site before commencement of construction operations.

1.4 SUBMITTALS

- A. Conform to requirements of Division 1.
- B. Schedule of testing, service connections, abandonment, backfill, and site restoration.
- C. Sample of notices to residents outlining their responsibility for maintenance of site improvements adjacent to the Project that are not disturbed by construction operations.

1.5 SCHEDULING

- A. Schedule testing, service connections, abandonment, backfill and site restoration immediately following completion of pipe laying work or paving within each block or line segment.

- B. Phased Construction:
 - 1. Commencement of subsequent Phase will follow scheduling of site restoration of prior Phase. Limit work to a maximum of two Phases of the project.
- C. Construction of Projects with no Phases listed in Division 1:
 - 1. Complete site restoration prior to disturbing over 50% of total project linear feet or 2,000 linear feet, whichever is greater, of right-of-way or easement.
 - 2. Limit work to a maximum of 50% of total project linear feet or 2,000 linear feet, whichever is greater, of right-of-way and easement. Commence work in additional right-of-way or easement after completion of site restoration.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Pavement, Sidewalks and Driveways: Materials specified in Division 2.
- B. Seeding and Sodding: Sod specified in Division 2.
- C. Trees, Shrubs and Plantings: Conform to requirements of Division 1.

PART 3 EXECUTION

3.1 PREPATORY WORK

- A. Provide cleanup and restoration crews to work closely behind pipe laying and roadway construction crews, and where necessary, during testing, service restoration, abandonment, backfill and surface restoration.
- B. Water Lines: Unless otherwise approved by Owner's Representative, comply with the following:
 - 1. Once Owner's Representative approves work within a Phase, immediately begin preparatory work for disinfection effort.
 - 2. No later than three days after completing disinfection preparatory work, initiate disinfection work.
 - 3. Immediately after transfer of services, begin abandonment of old water lines and site restoration.
- C. Wastewater Lines:
 - 1. Once Owner's Representative approves work within a Line Segment, immediately begin preparatory work for testing effort.
 - 2. No later than three days after completing preparatory work for testing, initiate testing work.
 - 3. Immediately after transfer of service connections, begin abandonment of old wastewater lines, and site restoration.
- D. Street Construction and Paving Projects
 - 1. Once Owner's Representative approves work within a Line Segment or block, immediately begin preparatory work for testing effort.

2. No later than three days after completing preparatory work for testing, initiate testing work.
3. Immediately after testing begin site restoration.

E. Street Construction and Paving Projects

1. Once Owner's Representative approves work within a block, immediately begin preparatory work for sidewalk construction, sodding and hydromulching and tree planting.
2. No later than seven days after completing preparatory work, initiate construction.

3.2 CLEANING

- A. Remove debris and trash to maintain a clean and orderly site in accordance with requirements of General Conditions and Division 1.

3.3 LANDSCAPING AND FENCES

A. Seeding and Sodding.

1. Remove construction debris and level area with bank sand so that new grass surface matches level of existing grass and maintains pre-construction drainage patterns. Level and fill minor ruts or depressions caused by construction operations with bank sand, where grass is still viable.
2. Restore previously existing turfed areas with sod and fertilize in accordance with Division 2. Sod to match existing turf.
3. Restore unpaved areas not requiring sodding with hydromulch seeding conforming to Division 2.

B. Trees, Shrubbery and Plants.

1. Remove and replant trees, shrubs, and plants in accordance with requirements of Division 1.

C. Fence Replacement.

1. Replace removed or damaged fencing to equal or better condition than existed prior to construction, including concrete footings and mow strips. Provide new wood posts, top and bottom railing, and panels. Metal fencing material, not damaged by the Work, may be reused.
2. Remove and dispose of damaged or substandard material.

3.4 MAINTENANCE

- A. Maintain shrubs, plantings, sodded areas, and seeded areas.
- B. Replace shrubs, plantings and seeded or sodded areas that fail to become established.
- C. Refer to Division 1 and Division 2 for maintenance requirements.

END OF SECTION

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**SECTION 02 82 13
ASBESTOS ABATEMENT**

1.0 SUMMARY OF WORK

1.01 DESCRIPTION

- A. Cypress Ridge High School scheduled work is to include interior and exterior renovations. Renovations will impact asbestos containing building materials in select areas of the Cypress Ridge High School campus.
- B. The work will include, but is not limited to, the following abatement scope of work in the subject work areas. Reference the attached abatement floor plans which identifies graphically the abatement scope of work.

Cypress-Fairbanks Independent School District:

Cypress Ridge High School – 7900 North Eldridge Parkway, Houston, Texas 77041

- 1. Interior Abatement
 - a. In locations designated by the General Contractor, and as shown by keynotes and legend on the abatement drawings, abate all non-friable, asbestos-containing interior **mirror mastic** located behind all mirrors in the cosmetology classroom and in the theater dressing rooms.

Note: Should additional asbestos containing materials need to be impacted or be discovered during demolition such as **black mirror mastic**, please notify EFI and CFISD so that the additional scope can be addressed prior to impact.

1.02 WORK NOT INCLUDED IN THE WORK PROCEDURES

- A. Replacement of any materials scheduled for removal as part of the Work.
- B. Air monitoring for Owner/Owner's Representative by Testing Laboratory.

1.03 EXISTING CONDITIONS

- A. Asbestos Abatement Contractor is advised that the locations of asbestos-containing materials are not clearly known and that it shall proceed with caution in all phases of the Work. Additional asbestos-containing material may be uncovered during the course of the Work and Asbestos Abatement Contractor may be directed by General Contractor to include this material in the Work at an agreed upon price.

1.04 BUILDING OCCUPANCY

- A. Owner/Owner's Representative and General Contractor will occupy all other portions of the facility other than the identified work area for the conduct of normal building or construction operations. Coordinate work with Owner/Owner's Representative and General Contractor and conduct activities so as to minimize disruption to the building occupants and to planned building activities.

1.05 STORAGE

- A. Limited storage space is available in the building and at the site. Store items only in areas designated by General Contractor. Supply any additional temporary storage areas required for storage of equipment and materials for duration of Project.

1.06 CONTRACTOR'S USE OF PREMISES

- A. Coordinate and follow General Contractor's building security/access requirements and sign in/sign out procedures.
- B. Limit use of premises to locations specified by General Contractor.

- C. Predetermine and obtain approval, in advance from General Contractor, for transportation route(s) for contaminated and non-contaminated waste materials, labor and construction materials into and out of the building and site.
- D. If required, coordinate with General Contractor for onsite material delivery/pickup and location of waste disposal container during the Project.
- E. Maintain existing building in a safe condition throughout the Project. Repair damage caused by abatement operations immediately. Take all precautions necessary to protect the building and its occupants during the Project.
- F. Keep work area and associated surrounding areas free from accumulation of waste, rubbish, or construction debris.
- G. Smoking or ignitable devices (e.g. matches, lighters, etc.) will not be permitted within the building or on the premises.
- H. Obtain approval from General Contractor prior to use of existing restroom facilities at the property by the Asbestos Abatement Contractor. Otherwise, Asbestos Abatement Contractor will provide portable toilets for its employees at locations to be approved by General Contractor.

1.07 SCHEDULING AND WORKING HOURS

- A. Contractor's abatement work operations may be performed during or after normal business hours, Monday through Friday, or on the weekends. Submit schedule to General Contractor for approval.
- B. Transportation of construction materials, abatement materials and asbestos waste materials from the work area shall be performed during hours approved by General Contractor.
- C. Obtain approval from General Contractor prior to altering work schedule.

1.08 PARKING

- A. Parking is limited at or near the site. Park only in specified parking areas designated by General Contractor. General Contractor assumes no responsibility for damage or theft to Contractor's vehicles. If necessary, park in offsite parking areas and pay all applicable parking fees.

1.09 BUILDING SECURITY

- A. Coordinate and follow Owner's/Owner's Representative's or General Contractor's building security requirements.
- B. Asbestos Abatement Contractor is responsible for the work area and its own supplies, equipment, and security.
- C. Secure work area completely at the end of each work shift.
- D. Maintain personnel at the asbestos waste disposal container at all times the container is open or not properly secured. Secure container completely at the end of each work shift.
- E. Install viewing windows to allow for observation of the entire work area or as designated by General Contractor or Asbestos Consultant.

1.10 FIRE PREVENTION

- A. Provide Type "A" fire extinguishers for temporary offices and similar spaces where there is minimal danger of electrical or grease-oil-flammable liquid fires. In other locations, provide type "ABC" dry chemical fire extinguishers, or a combination of several extinguishers per National Fire Protection Association (NFPA) recommendations and OSHA regulations.

- B. Asbestos Abatement Contractor's employees shall not enter building areas with cigarette lighters, matches, cigarettes, cigars, pipes or other flame emitting items. Asbestos Abatement Contractor's employees shall not smoke cigarettes, cigars, pipes or the like within the building areas.
- C. Flammable materials shall not be stored in the work area.

1.11 CONTINGENCY PLAN

- A. Prepare a contingency plan for emergencies including fire, fire alarms, accident, power failure, diminished pressure failure or any other emergency event. Incorporate building's emergency procedures as required. Note that nothing in the Work Procedures should impede safe exiting or providing of adequate medical attention in the event of an emergency.
- B. Post at the entrance to the work area telephone numbers and locations of emergency services including but not limited to the building security office.

1.12 PROJECT SUPERINTENDENT

- A. Maintain a "competent" full-time superintendent (as defined by OSHA, EPA and DSHS) and necessary assistants who shall be in attendance at the facility during the progress of the work. The superintendent shall be satisfactory to General Contractor and shall not be changed without prior approval by the General Contractor.

1.13 SEGREGATION OF WORK AREAS

- A. Segregate the work areas from the surrounding occupied or unoccupied areas.
 - 1. Install temporary construction barriers acceptable to General Contractor to segregate work areas and prevent occupant or public access and viewing of the work areas.
 - 2. Install black, frosted or opaque plastic sheeting over windows to prevent public viewing of the work areas.
 - 3. Install secure, temporary plywood barriers in windows, doorways or other openings used for diminished air exhaust. If required, coordinate with General Contractor for the removal of exterior windows/glass.
- B. Demarcate the work area with asbestos warning barrier tape and post asbestos warning signage as required.

1.14 PRE-JOB DAMAGE SURVEY OF FACILITY

- A. Perform a thorough survey of work area and the building ingress/egress path prior to starting the Work in order to prepare a list documenting existing damage. Items identified on this list will not be the responsibility of Asbestos Abatement Contractor unless further damaged by Asbestos Abatement Contractor during execution of Project. List shall be provided to General Contractor prior to proceeding with the Work.

1.15 CORRECTION OF DAMAGE TO FACILITY

- A. Consider any damage to work area and the building ingress/egress path not identified in the pre-job damage survey as having resulted from execution of the Work and correct, restore, repair and/or replace to General Contractor's satisfaction at no additional expense to General Contractor.

1.16 UTILITIES

- A. Asbestos Abatement Contractor may temporarily connect to available existing permanent utilities (e.g. water, sewer and electricity) during execution of the Work. Make connections in locations designated by General Contractor. The cost for the use of existing permanent utilities will be paid by Owner. If permanent utilities are not available, Asbestos Abatement

Contractor shall provide and pay for any temporary utilities during the Project. Remove connections and all extensions of utilities at Project completion.

1.17 SALVAGEABLE MATERIALS

- A. Consider all materials and items removed in the execution of the Work unsalvageable unless indicated otherwise by the General Contractor.

1.18 CLEANUP

- A. Dismantle and dispose of all temporary barriers erected to isolate the work areas at completion of Work.
- B. Leave all areas visibly clean at completion of Work.

2.0 SUBMITTALS

2.01 DESCRIPTION

- A. Make submittals required by the Work Procedures in a timely manner and at appropriate times in the execution of the Work to allow for sufficient and prompt review by Asbestos Consultant. Revise and resubmit as necessary to establish compliance with the specified requirements.

2.02 WORK INCLUDED

- A. Submit complete, bound sets of the submittals required herein. Submit complete sets entitled "Project Submittals".
- B. Update submittals to Asbestos Consultant to account for all new equipment and employees used on the Project.
- C. Project Submittals
 - 1. Submit one complete set of "Project Submittals" to Asbestos Consultant for review. Bind project submittals in a three-ring binder or cover with metal fasteners.

2.03 PROJECT SUBMITTALS

- A. Notice of impending commencement of asbestos removal work, and any amendments if required, in writing via regular mail to:

Environmental Health Notifications Group
Attention: Asbestos
Department of State Health Services
P. O. Box 143538
Austin, Texas 78714-3538

Or electronically:

Through the Department of State Health Services' Online Asbestos Notification System

and comply with the applicable notice period set forth in EPA 40 CFR 61.145 and Department of State Health Services (DSHS) asbestos regulations. In the case of an emergency and if applicable, contact DSHS and obtain a waiver to the typical notice period. Include one copy of notification and amendments, if applicable, in submittal package. Any required notification fees shall be paid by Asbestos Abatement Contractor.

- B. Copy of the Asbestos Abatement Contractor's license as an Asbestos Abatement Contractor in accordance with the Texas Department of State Health Services asbestos regulations.
- C. Personnel Submittals:

1. Listing of supervisory personnel (including foremen) and workers to be utilized on the Project. Listing shall be in alphabetical order and include each worker's social security number. Include copy of Texas Department of State Health Services License or Registration for each asbestos supervisor or worker to be used on the Project.
 2. Training documentation that each and every employee to be utilized on the Project has had instruction on the hazards of asbestos exposure, protective dress, use of showers, entry to and exit from work areas and on all aspects of work procedures and protective measures regarding asbestos removal.
 3. Certification from Asbestos Abatement Contractor that each and every worker to be utilized on the Project is actively involved in an employee medical surveillance program for asbestos exposure. Include copy of physician's written opinion for each person to be utilized on the Project.
 4. Individually signed forms by each and every worker to be utilized on the Project, documenting that each is actively involved in a company employee respirator protection program and has had appropriate training in respiratory protection.
 5. Individually signed Certificate of Worker's Release Form for each and every worker to be utilized on the Project.
- D. Properly completed copies of the Uniform Hazardous Waste Manifest (Texas Commission on Environmental Quality form TCEQ-0311, current edition, or EPA equivalent) from the landfill, documenting the disposal of the asbestos-containing/ contaminated waste material.
- E. Copy of the Sign In/Out Logs showing the following: date, name, social security number, entering and leaving time, company or agency represented.

2.04 ASBESTOS CONSULTANT'S REVIEW

- A. Partial submittals may be rejected for non-compliance with the Work Procedures.
- B. Review by Asbestos Consultant does not relieve Asbestos Abatement Contractor from responsibility for errors which may exist in the submitted data.
- C. Make revisions when required by Asbestos Consultant and resubmit for review.

3.0 TESTING LABORATORY SERVICES

3.01 DESCRIPTION

- A. Owner/Owner's Representative will provide a qualified Testing Laboratory to perform routine and special testing of the Work under these Work Procedures.
- B. Testing Laboratory representative will, in addition to performing routine and special testing necessary to determine general compliance with the Work Procedures, observe and document, on a daily basis, the execution and progress of the Work. Such observation and documentation shall be for the sole benefit of Owner/Owner's Representative and shall not be construed in any way as to include responsibility for Asbestos Abatement Contractor's means, methods, techniques, sequences or procedures involved with the execution of the Work. Nor shall such observation and documentation by Testing Laboratory be construed as to include responsibility for any safety programs or procedures either utilized or not utilized by Asbestos Abatement Contractor during the Work.
- C. Provision of the Testing Laboratory by Owner/Owner's Representative to perform testing for Owner/Owner's Representative shall not relieve the Asbestos Abatement Contractor from providing its own air testing for compliance with all applicable codes, regulations, requirements and as specified in this Section and elsewhere in the Work Procedures.

3.02 QUALITY ASSURANCE

- A. All environmental air testing shall be performed in general accordance with the procedures outlined in the National Institute for Occupational Safety and Health (NIOSH) Method No. 7400 and also will follow guidelines issued by the Environmental Protection Agency regarding detection limits.
- B. Final air testing will be performed using Phase Contrast Microscopy (PCM) analysis or Transmission Electron Microscopy (TEM) as specified in this Section and elsewhere in the Work Procedures.
- C. PCM final air samples will be analyzed in general accordance with the sample analysis procedures outlined in NIOSH Method No. 7400.
- D. TEM final air samples will be analyzed in general accordance with the sample analysis procedures outlined in the EPA 40 CFR Appendix A to Subpart E of Part 763 – Interim Transmission Electron Microscopy Analytical Methods.

3.03 PAYMENT FOR TESTING

- A. Owner/Owner’s Representative will pay for all daily environmental air testing and final air clearance testing as required by the Work Procedures.
- B. When additional testing is required due to Asbestos Abatement Contractor non-compliance with the Work Procedures, such testing will be performed by Testing Laboratory and all associated costs will be paid by Asbestos Abatement Contractor.

3.04 SCHEDULING

- A. Testing Laboratory will perform tests in areas and at times during the Work as deemed necessary by the Testing Laboratory and as specified in the Work Procedures.
- B. Notify Testing Laboratory of need for final air testing at least 2-4 hours prior to desired time of testing.
- C. Coordinate other scheduling with Testing Laboratory as necessary.

3.05 SCHEDULE OF AIR SAMPLES

- A. Before Start of Work:
 - 1. Testing Laboratory will collect, at a minimum, the following air samples to establish a base line before the start of work:

| BASE LINE SAMPLES | | | | |
|-------------------|-------------------|-----------------|-------------------------|----------|
| Sample Location | Number of Samples | Analysis Method | Minimum Volume (Liters) | Rate LPM |
| Work Area | 3 Minimum | PCM | 1250 | 10 to 16 |

- 2. Base Line: An action level expressed in fibers per cubic centimeter which, for PCM, is equal to the greater of the average of the samples collected on mixed cellulose ester filters in the work area prior to abatement activities or 0.01 fibers per cubic centimeter.
- B. Daily During the Course of the Work:
 - 1. Testing Laboratory will collect area samples in areas and at times during the work as deemed necessary by the Testing Laboratory, required by the Asbestos Consultant, or as specified in the Work Procedures. Daily samples will be analyzed using Phase Contrast Microscopy.

C. Final Air Clearance Samples:

1. Testing Laboratory will collect the following air samples to determine if the Asbestos Abatement Contractor may remove the demarcation barriers and demobilize from the site:

| FINAL AIR CLEARANCE FOR CONTAINMENT AREAS | | | | | |
|--|-----------------|---|-------------------------|----------|----------------------|
| Sample Location | Analysis Method | Number of Samples | Minimum Volume (Liters) | Rate LPM | Results |
| Non-Friable Materials (Excluding Flooring, floor tile/sheet flooring or floor mastic) | | | | | |
| Inside Work Area | PCM | 5 Minimum Per Work Area | 1250 | 10 to 16 | <0.01 |
| Friable Materials or Non-Friable Materials that have become Friable in the abatement process. (Including Flooring, floor tile/sheet flooring or floor mastic) | | | | | |
| Inside Work Area | PCM | 5 Minimum Per Work Area Less Than or Equal To 1 ARU (160 SQFT or 260LF or 3CF) | 1250 | 10 to 16 | <0.01 |
| Inside Work Area | TEM | 5 Minimum Per Work Area 3 Blanks (inside, outside and LAB) Greater Than 1 ARU (160 SQFT or 260LF or 3CF) | 1300 | Up to 10 | <70s/mm ² |

3.06 RESULTS

- A. Testing Laboratory will perform all testing and analysis promptly and issue results expeditiously in order to minimize any possible delay in the progress of the Work.
- B. Test results shall be available to General Contractor and Asbestos Abatement Contractor as follows:
 1. PCM Air clearance results: within 4 hours following tests.
 2. TEM Results deemed necessary by Asbestos Consultant: as quickly as possible but not earlier than 6 hours following completion of tests.
- C. Air tests will be made both inside and outside of work areas, as necessary. Asbestos Abatement Contractor is cautioned, however, that should interpretations be made, opinions be formed and conclusions be drawn as a result of examining the test results, these interpretations, opinions and conclusions will be those made, formed and drawn solely by Asbestos Abatement Contractor. Asbestos Abatement Contractor is responsible for performing air tests required for its evaluation of the safety of its employees.

4.0 ASBESTOS ABATEMENT

4.01 DESCRIPTION

- A. Perform all planning, administration, execution of work necessary to safely conduct the Work. The Work will consist of the abatement of asbestos-containing materials noted in section 1.01.B.
- B. Approval of or acceptance by Owner/Owner's Representative, General Contractor or Asbestos Consultant of various construction activities or methods proposed by Asbestos Abatement Contractor does not constitute an assumption of liability either by the

Owner/Owner's Representative, General Contractor or Asbestos Consultant for inadequacy or adverse consequences of said activities or methods.

4.02 DEFINITIONS

- A. The following definitions pertain to the Work of these Work Procedures.
1. **Abatement** - procedures to decrease or eliminate fiber release from precast, spray- or trowel-applied asbestos-containing building materials. Includes encapsulation, enclosure and removal.
 2. **ACM** - Asbestos-Containing Material.
 3. **Airlock** - system for permitting ingress or egress of personnel without permitting air movement between a contaminated area and an uncontaminated area, typically consisting of two curtained doorways at least 3 feet apart.
 4. **Air Monitoring** - the process of measuring the fiber content of a specific volume of air during a stated period of time.
 5. **Amended Water** - water to which a surfactant has been added.
 6. **ANSI** - American National Standards Institute.
 7. **ASTM** - American Society for Testing and Materials.
 8. **Clean Room** - an uncontaminated area or room which is part of the worker decontamination enclosure system, with provisions for storage of workers' street clothes and protective equipment. Also known as the "Change Room".
 9. **Critical Barrier** - Seal applied to openings connecting the abatement area with adjacent spaces that will not be included in the containment. Critical barriers shall not be exposed to the gross removal environment. Examples of openings requiring critical barriers include, but are not limited to: HVAC vents and diffusers; doorways; operable windows; floor, wall, and ceiling penetrations; and air plenums.
 10. **Curtained Doorway** - a device to allow ingress or egress from one room to another while minimizing air movement between the rooms. Two curtained doorways spaced a minimum of 3 feet apart form an airlock.
 11. **Decontamination Enclosure System** - a series of connected rooms, with curtained doorways between any two adjacent rooms, for the decontamination of workers or of materials and equipment. A worker decontamination enclosure system or an equipment decontamination system always contains at least three airlocks (rooms).
 12. **Encapsulation** - the sealing of asbestos surfaces involving application of a material (encapsulant) that will envelop or coat the fiber matrix and eliminate fiber fallout and protect against contact damage.
 13. **Enclosure** - procedures necessary to completely enclose material containing asbestos behind airtight, impermeable, permanent barriers.
 14. **EPA** - United States Environmental Protection Agency.
 15. **Equipment Decontamination Enclosure System** - a decontamination enclosure system for materials and equipment, typically consisting of an airlock, a washroom, and a holding area.
 16. **Equipment Room** - a contaminated area or room which is part of the worker decontamination enclosure system, with provisions for storage of contaminated clothing and equipment.
 17. **Fixed Object (Immoveable object)** - a unit of equipment or furniture in the work area which cannot be removed from the work area.
 18. **Glove-Bag** - A 6 to 12-mil plastic bag fitted with long-sleeved gloves, a tool pouch and an opening for amended water and sealant application.

19. **HEPA Filter** - a High Efficiency Particulate Absolute (HEPA) filter capable of trapping and retaining 99.97 percent of asbestos fibers greater than 0.3 microns in length.
20. **HEPA Vacuum Equipment** - vacuuming equipment equipped with a HEPA-filtration system.
21. **Holding Area** - a chamber between the washroom and uncontaminated area in the equipment decontamination enclosure system. The holding area comprises an airlock.
22. **Moveable Object** - a unit of equipment or furniture in the work area which can be removed from the work area.
23. **MSHA** - Mine Safety and Health Administration.
24. **NEC** - National Electrical Code.
25. **NESHAP** - National Emissions Standard for Hazardous Air Pollutants.
26. **NIOSH** - National Institute for Occupational Safety and Health.
27. **OSHA** - Occupational Safety and Health Administration.
28. **Plastic Sheeting** - plastic sheet material of specified thickness used for protection of walls, floors, etc., and used to seal openings into the work area. All plastic sheeting utilized on the project shall be fire retardant.
29. **PPE** - Personal protective equipment including respirators, disposable clothing, gloves, eye protection, hard hats, safety boots, safety vests, etc.
30. **Removal** - the act of removing asbestos-containing or contaminated materials from the structure under properly controlled conditions to a suitable disposal site.
31. **Shower Room** - a room constituting an airlock, between the clean room and the equipment room in the worker decontamination enclosure system, with hot and cold or warm running water suitably arranged for complete showering during decontamination.
32. **Surfactant** - a chemical wetting agent added to water to improve penetrating ability, thus reducing the quantity of water required to saturate asbestos-containing materials.
33. **Washroom** - a room between the work area and the holding area in the equipment decontamination enclosure system. The washroom comprises an air lock.
34. **Wet Cleaning** - the process of eliminating asbestos contamination from building surfaces and objects by using cloths, mops, or other cleaning tools which have been dampened with amended water, disposing of these cleaning tools as asbestos-contaminated waste.
35. **Work Area** - area or areas of Project which undergo abatement or are contaminated.
36. **Worker Decontamination Enclosure System** - a decontamination enclosure system for workers, typically consisting of a clean room, a curtained doorway or airlock, a shower room, a curtained doorway or airlock, and an equipment room.

4.03 REFERENCE STANDARDS

- A. Acknowledge awareness and familiarity with the contents and requirements of the following regulations, codes, standards, and guidance documents. Assume responsibility for the performance of the Work in strict compliance with these documents and for every instance of failure to comply with these documents. The current issue of each document shall govern. Where conflict exists between these documents and the Work Procedures, the more stringent requirements shall apply.
 1. EPA Regulations for Asbestos (40 CFR 61.140 - 61.157 and 40 CFR 763).
 2. OSHA Asbestos Regulations (29 CFR 1910, 29 CFR 1926).

3. EPA Office of Toxic Substances Guidance Document, "Asbestos-Containing Materials in School Buildings", Part I and Part II.
4. EPA Office of Pesticide and Toxic Substances Guidance Document, "Guidance for Controlling Friable Asbestos-Containing Materials in Buildings", EPA 560/5-85-024, June, 1985.
5. All state, county, and city codes and ordinances as applicable. Make available for review at the site one copy of EPA, OSHA, and applicable state, county and city regulations governing the Work.

4.04 WORKSITE CONDITIONS

- A. Worker and Visitor Procedures: Asbestos Abatement Contractor is hereby advised that asbestos has been determined by the U.S. Government to be a CANCER-CAUSING AGENT. Provide workers and visitors with respirators (which, as a minimum, meet the requirements of OSHA 29 CFR 1926.1101) and protective clothing during all phases of the Work and until final air tests are accepted by Asbestos Consultant.
- B. Airborne Fiber Concentration - Inside Work Area: Testing Laboratory will conduct prevalent levels prior to abatement operations, and daily air monitoring inside the work area to monitor the effectiveness of Asbestos Abatement Contractor's work practices during removal activities. The Testing Laboratory will provide the General Contractor a daily copy of the sample results. The following fiber concentrations will be based on environmental air samples obtained in the work area:
 1. Maintain an average airborne fiber concentration inside the work area of less than or equal to prevalent level or 0.05 fibers per cubic centimeter (f/cc), whichever is greater. If the average daily fiber counts obtained from the work area rise above this figure, revise work procedures to lower the fiber counts.
 2. Upon notification by the Testing Laboratory that the average airborne fiber concentrations exceed 0.1 fibers per cubic centimeter for any period of time, cease work and commence cleaning of the Work Area. Work activities may not resume until Testing Laboratory performs testing to obtain a fiber concentration less than or equal to prevalent level or 0.05 fibers per cubic centimeter, whichever is greater.
- C. Airborne Fiber Concentration - Outside Work Area: Testing Laboratory will conduct prevalent levels prior to abatement operations, and daily air monitoring outside the Work Area to monitor the effectiveness of Asbestos Abatement Contractor's work practices and work area enclosure during removal activities. The Testing Laboratory will provide the General Contractor a daily copy of the sample results. The following fiber concentrations will be based on environmental air samples obtained outside the work area:
 1. Maintain an airborne fiber concentration outside the work area less than or equal to prevalent level or 0.01 fibers per cubic centimeter (f/cc), whichever is greater. Upon notification by the Testing Laboratory, that the airborne fiber concentration exceeds this level, commence cleaning of the affected area. Continue cleaning until Testing Laboratory performs testing to obtain a fiber concentration less than or equal to prevalent level or 0.01 fibers per cubic centimeter, whichever is greater.
 2. Upon notification by the Testing Laboratory, that an airborne fiber concentration obtained outside the work area exceeds 0.05 fibers per cubic centimeter, cease work, restrict access into the affected area with the installation of barrier tape, and commence cleaning of the affected area. Review work procedures and work area enclosure for effectiveness, and review activities in the general location of the affected area for potential of creating airborne fibers. Report review findings to General Contractor and Asbestos Consultant. Continue cleaning until Testing Laboratory performs testing to obtain a fiber concentration less than or equal to prevalent level or 0.01 fibers per cubic centimeter, whichever is greater. General

Contractor may elect to perform additional testing at Asbestos Abatement Contractor's expense.

4.05 PERSONNEL PROTECTION

- A. Prior to commencement of work, instruct all workers in the appropriate procedures for personnel protection and asbestos removal. Ensure that workers are knowledgeable in these procedures.
- B. Provide respiratory protection at all times, which is in compliance with OSHA requirements. When not in violation of the above, the minimum acceptable respiratory protection used for this project shall be as follows, unless airborne fiber concentrations inside the face mask exceed 0.01 fibers per cubic centimeter (f/cc). In the event that airborne fiber concentrations inside the mask exceed 0.01 f/cc, respiratory protection required to achieve 0.01 f/cc shall be used.
 - 1. Provide a minimum of half-face dual cartridge respirators for workers during pre-cleaning of work area (including HEPA-vacuuuming of floors), installation of plastic sheeting, and waste handling and disposal activities outside the work area.
 - 2. Provide a minimum of Powered Air Purifying Respirator (PAPR) equipment for "friable" removal work and half-face respirators for "non-friable" removal work for workers during all phases of the Work from the time of first disturbance of the asbestos-containing/contaminated material until acceptance of final air clearance tests by Asbestos Consultant.
 - 3. Provide additional "piggy-back" cartridges recommended by the product or solvent manufacturer whenever solvents (e.g. mastic removers, spray adhesives, etc.) are used.
- C. Be solely responsible for scheduling necessary air sampling by an independent testing laboratory for compliance monitoring of own respiratory protection with OSHA regulations. Pay for all costs associated with such testing. In addition, submit copies of personal air monitoring results to Asbestos Consultant. If a prior negative exposure assessment (NEA) is used in lieu of employee air monitoring, provide documentation indicating that an NEA has been performed and include supporting documentation (e.g. the objective data used in the determination of the NEA).
- D. Permit no visitors, except for governmental inspectors having jurisdiction, or as authorized by General Contractor or Asbestos Consultant, in the work areas after commencement of asbestos disturbance or removal.
- E. Provide workers sufficient sets of protective disposable clothing, consisting of full-body coveralls, head covers, gloves, and foot covers, of sizes to properly fit individual workers.
- F. Leave reusable equipment, apparel and protection devices (excluding respirators) in the work area until the end of the asbestos abatement work, at which time such items shall be disposed of as contaminated waste or decontaminated for reuse.
- G. Provide suitable respirators and protective disposable clothing for use by authorized visitors, Owner/Owner's Representative, General Contractor, Asbestos Consultant and Testing Laboratory's representatives. Furnish these in as many sets as required for full-time monitoring by Testing Laboratory.
- H. Provide and post at the entrance to the work area the asbestos removal work procedures to be followed by workers.

4.06 OBSERVATIONS

- A. Asbestos Consultant will observe the status and progress of the Work for completeness and general compliance with the requirements of the Work Procedures. At a minimum, the observations will be conducted at the following times during the Project:
 - 1. During preparation of work areas.

2. Following complete preparation of work areas and prior to proceeding with actual disturbance of asbestos-containing material.
3. During removal of asbestos-containing material.
4. At designated times during the cleaning phases.
5. As appropriate during the work outlined elsewhere in the Work Procedures.

4.07 SIGN-IN/OUT LOG

- A. Maintain a Sign-In/Out Log in the immediate vicinity of the entrance to the work area. Maintain log from the time the first activity is performed involving the disturbance of asbestos-containing material until acceptance of the final air test results by Asbestos Consultant. Require all persons entering the work areas, including the Asbestos Abatement Contractor's workers, Asbestos Consultant, General Contractor, Owner/Owner's Representative or agents of the Owner/Owner's Representative, government officials to register each time upon entering and leaving work areas. Indicate name, last four numbers of the social security number, time, company, or agency represented and reason for entering work area.

4.08 MATERIALS

- A. **Glove-Bag** - Six-mil or greater thickness, in size sufficient to allow airtight seal around pipe. Separate tool pouch and openings for amended water or sealant and HEPA-vacuum must be present.
- B. **Impermeable Containers** - suitable to receive and retain asbestos-containing or contaminated materials until disposal at an approved site and labeled in accordance with OSHA Regulation 29CFR 1926.1101. Containers shall be both air and water tight.
- C. **Mastic Remover** - Manufactured by a reputable, established manufacturer of mastic (adhesive) remover materials and approved specifically for use in asbestos-contaminated environments. Provide product compatibility for usage in confined areas. Flash Point shall be greater than 140 degrees Fahrenheit as determined by ASTM D 92. Product waste shall not meet the definition of hazardous waste under the EPA hazardous waste regulations 40CFR 261.
- D. **Plastic Sheeting** - thicknesses as specified, in sizes to minimize the frequency of joints. All plastic sheeting utilized on the project shall be fire retardant.
- E. **Sealant (encapsulant)** - manufactured by reputable, established manufacturer of encapsulant/sealant materials and approved specifically for use in asbestos-contaminated environments. Determine compatibility of the sealant with the materials and conditions.
- F. **Surfactant (wetting agent)** - mixture of "Dust-Set Amended Water Base" (Matheson Chemical Corporation) or equivalent and water, mixed to manufacturer's specifications.
- G. **Tape** - glass fiber or other type capable of sealing joints of adjacent sheets of plastic and for attachment of plastic sheet to finished or unfinished surfaces under both dry and wet conditions.
- H. **TSP Cleaning Solution** - Trisodium phosphate cleaning solution, such as Sentinel 805 (Sentinel Chemical Company) or equivalent and water, mixed to manufacturer's specifications.
- I. **Warning Labels and Signs** - as required by OSHA 29CFR 1926.1101.
- J. **Other Materials** - provide all other materials, such as lumber, nails and hardware, which may be required to construct and dismantle the decontamination system and the barriers that isolate the work area.

4.09 TOOLS AND EQUIPMENT

- A. Provide suitable tools for asbestos-containing material removal.
 1. **Air Purifying Equipment (for internal recirculation in the work area)** - HEPA Filtration Systems or Electronic Precipitators. Verify that no internal air movement

system or purification equipment exhausts contaminated air from inside the work area into uncontaminated areas.

2. **Half-Face Respirator Equipment** - negative pressure, half-face air purifying respirators approved by NIOSH and MSHA for asbestos removal work.
3. **HEPA-Filtered Vacuum** - vacuum equipped with a HEPA filtration system.
4. **Powered Air Purifying Respirator (PAPR) Equipment** - powered air purifying respirators (PAPRs) approved by NIOSH and MSHA for asbestos removal work.
5. **Scrapers and Brushes** - as required to remove asbestos-containing materials.
6. **Transportation** - as required for loading, temporary storage, transit, and unloading of contaminated waste without exposure to persons or property. Use only enclosed trucks or dumpsters to haul waste containers to prevent loss or damage of containers in route to the landfill.
7. **Water Sprayer** - utilize airless or other low pressure sprayer for amended water application.

4.10 PREPARATION

- A. Coordinate with General Contractor for HVAC system supplying work area to remain off during all abatement activities. Alternatively, completely isolate HVAC system from the work area containment.
- B. Coordinate with General Contractor to identify, isolate and “make safe” all electrical, wiring, cabling, life safety, telephone/data/communication, etc. to be left in place. Clearly identify and mark all active systems or components to remain and protect from damage.
- C. Coordinate with General Contractor to remove movable objects from the work area as necessary to access asbestos-containing materials.
- D. Initial Work Area Preparation
 1. Erect temporary construction barriers and/or dust barriers as required to prevent building occupant or public viewing of the construction area.
 2. Install and entry vestibule or “airlock” at the entry of the construction area.
 3. Install construction warning tape and signs outside the construction area to prevent building occupant or public access to the construction area.
 4. Install asbestos warning barrier tape and signs inside the construction areas to segregate and demarcate the abatement work area within the construction area.
 5. Flammable materials (e.g. plastic sheeting, spray adhesives, etc.) shall not be stored in the work area.
 6. Maintain a Sign In/Out Log in the immediate area of the entrance to the work area to be utilized by every person, each time upon entering and leaving the work area.
- E. Preparation of Work Area Enclosure for the Removal of Mirror Mastic – Full Containment.
 1. Install barrier tape around the work area.
 2. Install critical barriers and seal all openings and equipment within work area with a minimum of two layers of 6-mil (true thickness) plastic sheeting. Where fire hazards exist install fire retardant plastic sheeting with the minimum of same thickness as stated above. Install one layer of 6 mil plastic sheeting as a tent type enclosure around the mirror locations from the wall to the floor or install one layer of plastic sheeting from the ceiling to the floor around the mirror locations.
 3. Install two layers of 6-mil plastic sheeting (true thickness) on the floor below the areas where the removal is to occur to act as a drop cloth.

4. Use decontamination procedures, as described here, for personnel in work area.
 - a. Two sets of protective disposable clothing will be work while in work area.
 - b. Remove the outer set of protective clothing inside the work area, immediately before entering the airlock.
 - c. HEPA-vacuum and remove the inner suit prior to leaving the airlock.
 - d. Dispose of all used protective clothing as asbestos-contaminated waste.
5. Place each work area under diminished air pressure utilizing HEPA filtration systems which comply with ANSI Z9.2-79, local exhaust ventilation.
6. Notify Asbestos Consultant for observation of the completion of work area preparation prior to disturbing asbestos-containing material.

4.11 REMOVAL OF ASBESTOS-CONTAINING MATERIAL

- A. Remove and properly dispose of all asbestos-containing materials scheduled for removal in the Work Procedures in accordance with the methods and procedures outlined in the OSHA 29CFR 1926.1101 and as more stringently specified herein.
- B. Removal of Black Mirror Mastic.
 1. Prepare work area as described in Item 4.10E.
 2. Remove mirrors and place them in properly labeled sealable plastic bags of 6-mil minimum thickness and dispose of. Any residual mirror mastic that remains on the gypsum board or CMU block walls should be removed. Any material that cannot be placed in 6-mil plastic bags shall be wrapped and sealed in two layers of 6-mil (true thickness) plastic sheeting and properly labeled.
 3. Notify Asbestos Consultant for observation of the completion of removal/cleaning.

4.12 CLEANUP AND CLEARANCE TESTING

- A. Provide general cleanup of work area concurrent with the removal of all asbestos-containing materials. Do not permit accumulation of debris on workspace floor.
- B. Cleanup Sequence
 1. Remove all visible accumulations of asbestos-containing material and debris.
 2. Carefully remove contaminated plastic sheeting on the walls or floor. Maintain plastic seals (i.e. critical barriers) on entrances, wall/floor penetrations, etc. Plastic sheeting must be double bagged in appropriately labeled 6-mil (true thickness) plastic bags.
 3. Wet clean and HEPA-vacuum any remaining debris.
 4. Notify Asbestos Consultant for observation of cleaning to determine completeness. Work area surfaces will be considered clean when free from dust, dirt, residue, or film resultant from abatement operations or other activities subordinate to these operations.
- C. Final Air Clearance Testing
 1. Testing Laboratory will conduct clearance testing of the work area as described in section 3.05C after the Asbestos Consultant has determined the work area is clean.
 2. PCM Clearances - Testing Laboratory will test for the final air clearance levels upon notice from Asbestos Abatement Contractor that work areas are considered by Asbestos Consultant as visually decontaminated. If the final air clearance samples indicate airborne fiber concentrations of less than or equal to ambient prevalent levels or 0.01 f/cc, whichever is greater, the work will be considered completed.

3. TEM Clearances - Testing Laboratory will test for the final air clearance levels upon notice from Asbestos Abatement Contractor that work areas are considered by Asbestos Consultant as visually decontaminated. If the final air clearance samples indicate airborne fiber concentrations of less than 70 structures per millimeters squared (s/mm²), the work will be considered completed.
4. Re-clean and continue to clean at Asbestos Abatement Contractor's expense, areas which do not comply with the specified final clearance level. Asbestos Abatement Contractor to bear cost of all follow-up tests necessitated by the failure of the air tests to meet the specified clearance level.
5. Upon achieving final air clearance, dismantle the work area barriers and signage.

4.13 DISPOSAL OF ASBESTOS-CONTAMINATED WASTE

- A. Perform bag decontamination procedures as follows:
 1. As bags are moved out of the work area, wet-wipe bags to remove all contamination from them before they are moved into an uncontaminated space.
 2. Place bagged waste into appropriately labeled second bag for transport to landfill.
 3. Label asbestos-containing/contaminated waste in accordance with EPA 40 CFR 61.150, including waste generator and location information.
 4. Transport bagged waste on-site inside an enclosed buggy. Enclose and secure top of buggy with a minimum of 6-mil opaque plastic sheeting.
- B. Transportation to landfill shall be performed in accordance with all federal, state, and local laws and regulations.
 1. Place bags in the lockable, fully enclosed, metal waste disposal container, which has been lined with a minimum of one layer of 6-mil plastic sheeting. Plastic sheeting for the transport shall be reinforced type.
 2. Transport contaminated waste using a transporter licensed by the Texas Department of State Health Services to transport asbestos waste.
 3. Provide Texas Commission on Environmental Quality manifests (or EPA equivalent) for transportation of all contaminated waste to landfill.
- C. Remove sealed and labeled bags of contaminated material and wastes, and transport them for disposal to an approved landfill as follows:
 1. Notify Asbestos Consultant prior to removing each waste disposal container from the jobsite.
 2. Dispose of treated, packaged, labeled, asbestos-containing waste material in accordance with EPA 40 CFR 61.150.
 3. Allow only sealed plastic bags or impermeable containers to be deposited in landfill.
 4. Ensure that there are no visible emissions to the outside air from site where materials and waste are deposited.
 5. Submit copies of receipts from authorized representative of landfill operator for each delivery of waste material to Asbestos Consultant after each delivery and a complete set of copies of receipts for all deliveries.

4.14 SCHEDULING

- A. Asbestos Consultant will perform observations in areas and at times during the Work as deemed necessary by the Asbestos Consultant and as specified in the Work Procedures.
- B. Coordinate scheduling of observations with Asbestos Consultant as necessary. Should advance notice not be given to Asbestos Consultant, Asbestos Consultant will make reasonable effort to comply with time of requested observations. Do not proceed until such observations by Asbestos Consultant are made. Any delay in the completion of the Project

caused by lack of advance notice by Asbestos Abatement Contractor to Asbestos Consultant shall not be sufficient cause for any extension of time or extension of the Project completion deadline.

5.0 ELECTRICAL WORK

5.01 DESCRIPTION

- A. Work included:
 - 1. Installation of temporary lighting and power necessary to perform the Work.
 - 2. Installation of Ground Fault Circuit Interrupters (GFCI) for Asbestos Abatement Contractor's and Asbestos Consultant's equipment.
 - 3. All electrical tie-ins are to be performed by licensed electricians.
- B. All materials and equipment required shall be:
 - 1. Approved by Underwriters Laboratories and so labeled.
 - 2. For wire and cable, marked as required by Article 310-10 National Electrical Code.
 - 3. Installed by mechanics skilled in their trades, working under the direct supervision of competent experienced foremen or superintendents.
 - 4. Installed in compliance with all applicable Occupational Safety and Health Administration and city electrical codes.
- C. Install items specified at the proper time during progress of construction. Coordinate work operations with other trades as necessary.
- D. Decontaminate and remove all temporary lighting and other electrical items after completion of asbestos-containing material removal operations.

END OF SECTION 02 82 13

SECTION 03 05 80 - UNDER-SLAB VAPOR BARRIER - RETARDER

PART 1 – GENERAL

1.1 SUMMARY

- A. Products supplied under this section:
 - 1. Vapor barrier and installation accessories for installation under concrete slabs.
- B. Related sections:
 - 1. Section 03 3000 Cast-in-Place Concrete

1.2 REFERENCES

- A. ASTM International
 - 1. ASTM E1745-17: Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs.
 - 2. ASTM E1643-18a: Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.
- B. Technical Reference - American Concrete Institute (ACI):
 - 1. ACI 302.2R-06: Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials.
 - 2. ACI 302.1R-15: Guide to Concrete Floor and Slab Construction.

1.3 SUBMITTALS

- A. Quality control/assurance:
 - 1. Summary of test results per paragraph 9.3 of ASTM E1745.
 - 2. Manufacturer's samples and literature.
 - 3. Manufacturer's installation instructions for placement, seaming, penetration prevention and repair, and perimeter seal per ASTM E1643.
 - 4. All mandatory ASTM E1745 testing must be performed on a single production roll per ASTM E1745 Section 8.1.
 - 5. Contact vapor barrier manufacturer to schedule a pre-construction meeting and to coordinate a review, in-person or digital, of the vapor barrier installation.
 - 6. Vapor barrier manufacturer must warrant in writing (a) compliance with the designated ASTM E1745 classification, and (b) no manufacturing defects in the product for, at least, the Life of the Building.
 - 7. Manufacturer verify in writing 20 years in the industry with no reported product failures.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Vapor barrier shall have all the following qualities:
 - 1. Maintain permeance of less than 0.01 Perms [grains/(ft² · hr · inHg)] as tested in accordance with mandatory conditioning tests per ASTM E1745 Section 7.1 (7.1.1-7.1.5).
 - 2. Other performance criteria:
 - a. Strength: ASTM E1745 Class A.

- b. Thickness: 15 mils minimum
 - 3. Provide third party documentation that all testing was performed on a single production roll per ASTM E1745 Section 8.1
 - 4. Warranty: (a) compliance with the designated ASTM E1745 classification, and (b) no manufacturing defects in the product for, at least, the Life of the Building.
- B. Vapor barrier products:
 - 1. Basis of Design: Stego Wrap Vapor Barrier (15-mil) by Stego Industries LLC., (877) 464-7834 www.stegoindustries.com
 - 2. No Substitutions

2.2 ACCESSORIES

- A. Seams:
 - 1. Stego Tape by Stego Industries LLC, (877) 464-7834 www.stegoindustries.com.
- B. Sealing Penetrations of Vapor barrier:
 - 1. Stego Mastic by Stego Industries LLC, (877) 464-7834 www.stegoindustries.com.
 - 2. Stego Tape by Stego Industries LLC, (877) 464-7834 www.stegoindustries.com.
- C. Perimeter/terminated edge seal:
 - 1. Stego Crete Claw (textured tape) by Stego Industries LLC, (877) 464-7834 www.stegoindustries.com.
 - 2. Stego Term Bar by Stego Industries LLC, (877) 464-7834 www.stegoindustries.com.
 - 3. StegoTack Tape (double-sided sealant tape) by Stego Industries LLC, (877) 464-7834 www.stegoindustries.com.
 - 4. One-sided seaming tape is not a recommended method of sealing at the terminated edge.
- D. Penetration Prevention:
 - 1. Beast Foot by Stego Industries LLC, (877) 464-7834 www.stegoindustries.com.
 - 2. Beast Form Stake by Stego Industries LLC, (877) 464-7834 www.stegoindustries.com
- E. Vapor Barrier-Safe Hand Screed System
 - 1. Beast Screed by Stego Industries, LLC, (877) 464-7834 www.stegoindustries.com.

PART 3 – EXECUTION

3.1 PREPARATION

- A. Ensure that subsoil is approved by Architect or Geotechnical Engineer.
 - 1. Level and compact base material.
- B. Contact vapor barrier manufacturer to schedule a pre-construction meeting and to coordinate a review, in-person or digital, of the vapor barrier installation.

3.2 INSTALLATION

- A. Install vapor barrier in accordance ASTM E1643.

1. Unroll vapor barrier with the longest dimension parallel with the direction of the concrete placement and face laps away from the expected direction of the placement whenever possible.
2. Extend vapor barrier to the perimeter of the slab. If practicable, terminate it at the top of the slab, otherwise (a) at a point acceptable to the structural engineer or (b) where obstructed by impediments, such as dowels, water stops, or any other site condition requiring early termination of the vapor barrier. At the point of termination, seal vapor barrier to the foundation wall, grade beam or slab itself.
 - a. Seal vapor barrier to the entire slab perimeter using manufacturer's textured tape with a surface that creates a mechanical seal to freshly-placed concrete, per manufacturer's instructions.
 - OR
 - b. Seal vapor barrier to the entire perimeter wall or footing/grade beam with manufacturer's double-sided tape, or both termination bar and double-sided tape, per manufacturer's instructions. Ensure the concrete is clean and dry prior to adhering tape.
3. Overlap joints 6 inches and seal with manufacturer's seam tape.
4. Apply seam tape/textured tape/double-sided tape to a clean and dry vapor barrier.
5. Seal all penetrations (including pipes) per manufacturer's instructions.
6. Avoid the use of stakes driven through vapor barrier by utilizing vapor barrier-safe, peel-and-stick screed and forming penetration prevention systems. Ensure peel-and-stick adhesive base is fully adhered to the vapor barrier.
7. Repair damaged areas with vapor barrier material of similar (or better) permeance, puncture and tensile.

END OF SECTION

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 4523 "Testing and Inspection Services".
 - 2. Section 03 3000 "Cast In Place Concrete".
 - 3. Section 03 2000 "Concrete Reinforcing".
 - 4. Section 03 3816 "Unbonded Post Tensioned Concrete".

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 Section 01 4523.

- C. Layout and measurement of concrete forms and embedment's, required for work, performed by a licensed surveyor employed by the contractor.
- D. Design, engineering and construction, and removal of formwork are the responsibility of the contractor.
- E. 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."
- F. 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. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.
- G. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.

- H. 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.
 - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- I. 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.
 - 1. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
 - 2. Furnish ties that, when removed, will leave holes no larger than 1 inch in diameter in concrete surface.
 - 3. 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

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 4523 "Testing and Inspection Services".
 2. Section 03 1000 "Concrete Forming and Accessories".
 3. Section 03 3000 "Cast In Place Concrete".
 4. Section 03 3816 "Unbonded Post Tensioned Concrete".
 5. Section 04 2200 "Concrete Unit Masonry".
 6. Section 31 2000 "Earth Moving".
 7. Section 31 6329 "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. 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.
- B. American Society of Testing Materials (ASTM)

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- 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.
- C. 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 4523.
- B. Installer Qualifications: An experienced installer who has completed reinforcing installation work similar in material, design, and extent to that indicated for this Project

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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 according to 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 for #6 and smaller bars, Grade 75 for #7 and larger bars, 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. Stainless-Steel Reinforcing Bars: ASTM A 955, Grade 60, [Type 304] [Type 316L], deformed.
- E. Steel Bar Mats: ASTM A 184, fabricated from ASTM A 615, Grade 60 or ASTM A 706, deformed bars, assembled with clips.
- F. Plain-Steel Wire: ASTM A 82, as drawn .
- G. Deformed-Steel Wire: ASTM A 496.

- H. Plain-Steel Welded Wire Reinforcement: ASTM A 185, plain, fabricated from as-drawn steel wire into flat sheets.
- I. 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 supports 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. 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. 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 $\frac{1}{4}$ inch.
 - 2. Minimum spacing between bars: Minus $\frac{1}{4}$ inch.
 - 3. Top bars in slabs and beams:
 - a. Members 8 inches deep or less: Plus or minus $\frac{1}{4}$ inch.
 - b. Members between 8 and 24 inches deep: Plus or minus $\frac{1}{2}$ 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 4523.
- B. Inspections:
 - 1. Steel reinforcement placement.
 - 2. Steel reinforcement welding.

END OF SECTION

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.
 - 8. Repair overlayment at stage flooring and elsewhere, where indicated.
- B. Related Sections:
 - 1. Section 01 4523 "Structural Testing and Inspection Services".
 - 2. Section 03 2000 "Concrete Forming and Accessories".
 - 3. Section 03 1000 "Concrete Reinforcing".
 - 4. Section 03 0580 "Under-slab Vapor Barrier – Retarder".
 - 5. Section 31 6329 "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.

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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 2000.
- D. Formwork Shop Drawings: Refer Section 03 1000.
- 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 4523.
 - 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. Moisture Vapor Reduction Admixture Testing Agent Qualifications:

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1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
- E. 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.
- F. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4, "Structural Welding Code - Reinforcing Steel."
- G. 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."
- H. 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.
- I. 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.

1.9 WARRANTY

- A. Moisture Vapor Reduction Admixture (MVRA):
 1. MVRA must be installed according to, and in compliance with, the manufacturer's published data sheets to include, but not limited to:
 - a. Dosing instructions.
 - b. Onsite representation requirements.
 - c. Use of an ASTM E 1745 vapor retarder installed following ASTM E 1643 and ASTM F710 guidelines.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

- A. See Section 03 1000.

2.2 STEEL REINFORCEMENT

- A. See Section 03 2000.

2.3 REINFORCEMENT ACCESSORIES

- A. See Section 03 2000.

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.
 - 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.

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6. Plasticizing and Retarding Admixture: ASTM C 1017, Type II.
- C. Moisture Vapor Reduction Admixture: For use in all interior slabs and elevated floor slabs on metal deck.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Barrier One Incorporated; High Performance Concrete Admixture or comparable product by one of the following:
 - a. Vaporlock 20/20: Concrete Admixture
 - b. Moxie International, Inc.; Moxie Shield 1800 Admixture
 - c. ISE Logik Industries, Inc.; MVRS 900
 - d. Failure to provide a product that meets or exceeds the MVRA warranty requirements of Part I and the MVRA field quality control requirements of Part 3 will result in all subsequent testing and slab remediation costs being borne by the ready mix supplier.
 2. Description: Concrete moisture vapor reduction admixture for all interior slabs on ground and elevated floor slabs on metal deck shall be a non-toxic liquid admixture specifically designed to have a natural chemical reaction with pre-existing elements inside the concrete to eliminate the route of moisture vapor emission through the slab by restricting the integral capillary system. Chemical reaction shall form a permanent barrier (capillary break) that is integral to the concrete, insoluble, and irremovable.

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.

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2.8 VAPOR RETARDERS

- A. See Section 03 0580.

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 Alox.
 - b. BASF Construction Chemicals - Building Systems; Frictex NS.
 - c. L&M Construction Chemicals, Inc.; Grip It AO.

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. BASF Construction Chemicals - Building Systems; Confilm.
 - c. ChemMasters; SprayFilm.
 - d. Conspec by Dayton Superior; Aquafilm.
 - e. Dayton Superior Corporation; Sure Film (J-74).
 - f. Edoco by Dayton Superior; BurkeFilm.
 - g. Euclid Chemical Company (The), an RPM company; Eucobar.
 - h. Kaufman Products, Inc.; Vapor-Aid.
 - i. Lambert Corporation; LAMBCO Skin.
 - j. L&M Construction Chemicals, Inc.; E-CON.
 - 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. BASF Construction Chemicals - Building Systems; Kure 200.
 - c. ChemMasters; Safe-Cure Clear.
 - d. Conspec by Dayton Superior; W.B. Resin Cure.
 - e. Dayton Superior Corporation; Day-Chem Rez Cure (J-11-W).
 - f. Edoco by Dayton Superior; Res X Cure WB.
 - g. Euclid Chemical Company (The), an RPM company; Kurez W VOX; TAMMSCURE WB 30C.

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- h. Kaufman Products, Inc.; Thinfilm 420.
 - i. Lambert Corporation; AQUA KURE - CLEAR.
 - j. L&M Construction Chemicals, Inc.; L&M Cure R.
 - k. Meadows, W. R., Inc.; 1100-CLEAR.
 - l. Nox-Crete Products Group; Resin Cure E.
 - m. Right Pointe; Clear Water Resin.
 - n. SpecChem, LLC; Spec Rez Clear.
 - o. Symons by Dayton Superior; Resi-Chem Clear.
 - p. TK Products, Division of Sierra Corporation; TK-2519 DC WB.
 - q. 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. BASF Construction Chemicals - Building Systems; Kure 1315.
 - b. ChemMasters; Polyseal WB.
 - c. Conspec by Dayton Superior; Sealcure 1315 WB.
 - d. Edoco by Dayton Superior; Cureseal 1315 WB.
 - e. Euclid Chemical Company (The), an RPM company; Super Diamond Clear VOX; LusterSeal WB 300.
 - f. Kaufman Products, Inc.; Sure Cure 25 Emulsion.
 - g. Lambert Corporation; UV Safe Seal.
 - h. L&M Construction Chemicals, Inc.; Lumiseal WB Plus.
 - 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.

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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.

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.
- B. Slabs at grade and elevated slabs on deck: Comply with Paragraph 2.18A and as follows:
 - 1. Moisture Vapor Reduction Admixture: Dose at 14 ounces per 100 pounds of total cementitious materials. Remove an equal part of water from the mix. Add separately from other admixtures at the tail end of the load.

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 1 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."

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2. Install dovetail anchor slots in concrete structures as indicated.

3.3 REMOVING AND REUSING FORMS

- A. See Section 03 1000.

3.4 SHORES AND RESHORES

- A. See Section 03 1000.

3.5 VAPOR RETARDERS/BARRIERS

- A. See Section 03 0580.

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.

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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

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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, restraightening, 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

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low spots. Repeat float passes and restraightening 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.

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, Fl =25; with minimum local values of flatness, Ff =24; and levelness, Fl =17.
 2. Carpeted floors, floors under concrete toppings, thickset tile and terrazzo: Specified overall values of flatness, Ff =25; and levelness, Fl = 20; with minimum local values of flatness, Ff =17; and levelness, Fl =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.

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- 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 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.

3.15 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.

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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.

3.16 FIELD QUALITY CONTROL

- A. Testing and Inspecting: See Section 01 4523.
 - 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.

END OF SECTION

SECTION 03 35 13 - CONCRETE FLOOR FINISHING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Surface treatment applied to cured concrete floors:
 - 1. Film-forming concrete sealer.
- B. Related Sections:
 - 1. Section 03 30 00 - Cast-in-Place Concrete: Prepared concrete floors ready to receive finish.
 - 2. Section 07 92 00 - Joint Sealants: Joint sealants applied to finished floors.

1.2 SUBMITTALS

- A. Product Data: For each product indicated, including:
 - 1. Manufacturer's specifications and test data.
 - 2. Manufacturer's recommended installation procedures.
- B. Test Reports: Provide certified test reports, prepared by an independent testing laboratory, confirming compliance with specified performance criteria.
- C. Maintenance Data: Provide data on maintenance renewal of applied coatings.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of products required for this Project.
 - 1. Engage an installer who is certified in writing by manufacturer as qualified to apply products indicated.
- B. Mockups: Apply mockups of each type finish, to demonstrate typical joints, surface finish, color variation, and quality standards for materials and workmanship.
 - 1. Apply full-thickness mockups on 50 sf area selected by Architect.
 - 2. Simulate finished lighting conditions for Architect's review of mockups.
 - 3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- C. Protection of Installed Slabs Receiving Floor Finishing: Protect concrete slabs against petroleum stains throughout construction, as stains cannot be removed satisfactorily.
 - 1. Diaper all hydraulic-powered equipment.
 - 2. Avoid parking vehicles on slab; If vehicles are necessary for the Work, place drop cloths under vehicles at all times.
 - 3. Do not operate pipe cutting machines on slab.
 - 4. Do not store steel on slab.
 - 5. Do not allow acids and acidic detergents to come into contact with slab.

- D. Preinstallation Conference: Conduct conference at Project site.

1.4 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.

1.5 FIELD CONDITIONS

- A. Coordinate the work with concrete floor placement and concrete floor curing.
- B. Maintain light level equivalent to minimum 200 W light source, placed 8 feet above the floor surface, for each 425 sq ft of floor being finished.
- C. Provide ventilation sufficient to prevent injurious gases from temporary heat or other sources affecting concrete.
- D. Do not finish floors until interior heating system is operational.
- E. Maintain ambient temperature of 50 degrees F minimum.
- F. Close area to traffic after installation for time period recommended in writing by manufacturer.

PART 2 - PRODUCTS

2.1 FILM-FORMING CONCRETE SEALERS

- A. General Sealer for Interior Concrete Floors: High-solids, waterbased, modified acrylic liquid polymer curing and sealing compound with the following characteristics:
 1. ASTM C309, Type 1, Class A and Class B.
 2. Solids Content: Minimum 20 percent by weight.
 3. VOC Content: 350 g/l maximum.
 4. Products: Subject to compliance with requirements provide one of the following:
 - a. Master Builders Solutions, MasterKure CC 200 WB: www.master-builders-solutions.com.
 - b. Dayton Superior Corporation, Cure & Seal 1315 J22WB: www.daytonsuperior.com.
 - c. Euclid Chemical Co., Super Aqua-Cure VOX; www.euclidchemical.com.
 - d. Laticrete, L&M Dress & Seal WB 25: www.laticrete.com.
 - e. W.R. Meadows, Vocomp-20; www.wrmeadows.com.

2.2 ACCESSORIES

- A. Patching and Leveling Material: Moisture-, mildew-, and alkali-resistant product recommended in writing by sealer manufacturer and with minimum of 3000-psi compressive strength after 28 days when tested according to ASTM C109/C109M.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrate, with installer present, for conditions affecting performance of finish. Correct conditions detrimental to timely and proper work. Do not proceed until unsatisfactory conditions are corrected.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
 - 1. Installation of system indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Clean substrate of substances that might interfere with penetration or performance of sealer. Test for moisture content, according to manufacturer's written instructions, to ensure that surface is dry.
- B. Repair damaged and deteriorated concrete according to manufacturer's written instructions.
 - 1. Fill surface depressions and irregularities larger than the size of a dime with patching and leveling material.
- C. Protect adjacent work, including sealant bond surfaces, from spillage or blow-over of sealer.
- D. Coordination with Sealants: Do not apply sealer until adjacent joint sealants have been installed and cured.
 - 1. Floor finishing may precede sealant application only if sealant adhesion and compatibility have been tested and verified using substrate, finish, and sealant materials identical to those used in the work.
- E. Broom sweep and vacuum prepared concrete.

3.3 APPLICATION

- A. Apply floor finishes in accordance with manufacturer's written instructions.
- B. Sealer: Apply two coats to scheduled floors by power spray or roller to the point of saturation. Remove excess material; do not allow material to puddle beyond saturation.
 - 1. Minimum Application Rate: Not less than manufacturer's recommended rate.

3.4 CLEANING

- A. Immediately clean water repellent from adjoining surfaces and surfaces soiled or damaged by water-repellent application as work progresses. Correct damage to work of other trades caused by water-repellent application, as approved by Architect.
- B. Comply with manufacturer's written cleaning instructions.

END OF SECTION

SECTION 03 52 16 - LIGHTWEIGHT INSULATING CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cast-in-place vermiculite aggregate lightweight insulating concrete.

B. Related Requirements:

1. Section 03 30 00 "Cast-in-Place Concrete" for requirements for normal-weight concrete, including concrete materials and mixes.
2. Section 07 52 00 "Modified Bituminous Membrane Roofing" for single source warranty covering roof deck, roof membrane, and metal flashings.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- B. Shop Drawings: For lightweight insulating concrete.

1. Include plans, sections, and details showing roof slopes, thicknesses, and embedded insulation board.
2. Indicate locations of penetrations, perimeter terminations and curbs, control and expansion joints, and drains.

- C. Design Mixtures: For each lightweight insulating concrete mixture.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

- B. Product Certificates: For the following:

1. Cementitious materials.
2. Lightweight aggregates.
3. Admixtures.
4. Molded-polystyrene insulation board.

- C. Evaluation Reports: For lightweight insulating concrete, from ICC-ES.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in placing lightweight concrete fill material specified in this section and that employs installers and supervisors who are trained and approved by manufacturer.

1.6 FIELD CONDITIONS

- A. Do not place lightweight insulating concrete unless ambient temperature is at least 40 deg F and rising.
 - 1. When air temperature has fallen or is expected to fall below 40 deg F, heat water to a maximum 120 deg F before mixing so lightweight insulating concrete, at point of placement, reaches a temperature of 50 deg F minimum and 80 deg F maximum.
- B. Do not place lightweight insulating concrete during rain or snow or on surfaces covered with standing water, snow, or ice.

1.7 WARRANTY

- A. Roofing Membrane and Lightweight Insulating Concrete Manufacturer's Warranty: Warrant the roof deck, membrane 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 roof system shall be a single source warranty to include lightweight insulating concrete deck, roof membrane, flashing, metal work, and other associated roofing materials. Repair of the system, including materials and labor, shall be done at no cost to the Owner.
- B. Warranty shall cover wind damage up to design wind speed specified in Section 07 52 00 "Modified Bituminous Membrane Roofing." Contractor shall purchase special "wind rider" as necessary to insure the 20- year roof warranties will provide total roof replacement for the wind loads specified with no exclusions.
- C. Additional items to be covered by the roof warranty include:
 - 1. Actual resistance to heat flow through the roof deck shall remain at least 80 percent of the design thermal resistance, provided that the roof membrane is free of leaks. Should a roof leak occur, the insulating performance of the roof deck shall remain at least 80 percent of the design thermal resistance for 2 years following repair of the leak.
 - 2. The roof deck shall remain in a reroofable condition should the roof membrane require replacement, excluding damage caused by fastener pullout during removal of the membrane.
 - 3. Materials used in construction of the roof deck shall not cause structural damage resulting from expansion or thermal or chemical action.
- D. Make arrangements with the lightweight insulating concrete 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 PERFORMANCE REQUIREMENTS

- A. Minimum Thermal Resistance of Installed System: R-25.
- B. Roof Deck must meet current requirements of IECC.

- C. FM Global Listing: Lightweight insulating concrete along with other roofing components shall comply with requirements in FM Global 4454 as part of a roof assembly, and shall be listed in FM Global's "RoofNav" for Class 1 or noncombustible construction, as applicable.

2.2 AGGREGATE LIGHTWEIGHT INSULATING CONCRETE

- A. Manufacturers:
 - 1. Subject to compliance with requirements, provide one of the following:
 - a. Zonolite Insulating Concrete (ZIC) as manufactured by Siplast.
 - b. Vermalite as manufactured by Vermiculite Products Inc.
- B. Produce aggregate lightweight insulating concrete using the minimum amount of water necessary to produce a workable mix.
- C. Vermiculite Aggregate Mix: Lightweight insulating concrete produced from cementitious materials, water, air-entraining admixture, and vermiculite mineral aggregates complying with ASTM C332, Group I.
 - 1. Asbestos Content: No detectable asbestos as determined by method specified in 40 CFR 763, Subpart E, Appendix E, Section 1, "Polarized Light Microscopy."
 - 2. As-Cast Unit Weight: 48 to 60 lb/cu. ft. at point of placement, when tested according to ASTM C138/C138M.
 - 3. Oven-Dry Unit Weight: 25 to 32 lb/cu. ft., when tested according to ASTM C495.
 - 4. Compressive Strength: Minimum 200 psi, when tested according to ASTM C495.
 - 5. Cement-to-Aggregate Ratio, by Volume: 1:6.

2.3 MATERIALS

- A. Cementitious Material: Portland cement, ASTM C150/C150M, Type I or III.
- B. Water: Clean, potable.
- C. Reinforcing: Polypropylene fibers, 3/4 inch long.
 - 1. Basis-of-Design: Fibermesh as manufactured by Sika Corporation.
- D. Molded-Polystyrene Insulation Board: ASTM C578, Type I, 0.90-lb/cu. ft. minimum density.
 - 1. Provide units with manufacturer's standard keying slots or holes of 3 to 4 percent of board's gross surface area.
 - 2. Basis-of-Design: Insulperm as manufactured by Siplast, or Vernaperm as manufactured by Vermiculite Products, Inc.

2.4 DESIGN MIXTURES

- A. Prepare design mixtures for each type and strength of lightweight insulating concrete by laboratory trial batch method or by field-test data method. For trial batch method, use a qualified independent testing agency for preparing and reporting proposed mixture designs.
- B. Limit water-soluble chloride ions to the maximum percentage by weight of cement or cementitious material permitted by ACI 301.

PART 3 - EXECUTION

3.1 MIXING AND PLACING

- A. Mix and place lightweight insulating concrete according to manufacturer's written instructions, using equipment and procedures to avoid segregation of mixture.
- B. Install insulation board according to lightweight insulating concrete manufacturer's written instructions. Place insulation board in wet, lightweight insulating concrete slurry poured a minimum of 1/8 inch over the structural substrate. Ensure full contact of insulation board with slurry. Stagger joints and tightly butt insulation boards. Allow slurry coat to set prior to placing remaining thickness of lightweight insulating concrete.
 - 1. Install insulation board in a stair-step configuration with a maximum step-down of 1 inch.
- C. Deposit and screed lightweight insulating concrete in a continuous operation until an entire panel or section of roof area is completed. Do not vibrate or work mix except for screeding or floating. Place to depths and slopes indicated.
- D. Finish top surface smooth, free of ridges and depressions, and maintain surface in condition to receive subsequent roofing system.
- E. Begin curing operations immediately after placement, and air cure for not less than three days, according to manufacturer's written instructions.
- F. If ambient temperature falls below 32 deg F, protect lightweight insulating concrete from freezing and maintain temperature recommended by manufacturer for 72 hours after placement.

3.2 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to sample materials and perform tests and inspections.
- B. Owner's Inspections: The Owner or Owner's testing agency will observe the installation of the lightweight insulating concrete full time. Cooperate with Owner or Owner's testing agency and correct work that is not in conformance with contract requirements.
- C. Testing of samples of lightweight insulating concrete obtained according to ASTM C172/C172M, except as modified by ASTM C495, shall be performed according to the following requirements:
 - 1. Determine as-cast unit weight during each hour of placement, according to ASTM C138/C138M.
 - 2. Determine oven-dry unit weight and compressive strength according to ASTM C495. Make a set of at least six molds for each day's placement, but not less than one set of molds for each 5000 sq. ft. of roof area.
 - 3. Perform additional tests when test results indicate that as-cast unit weight, oven-dry unit weight, compressive strength, or other requirements have not been met.
 - a. Retest cast-in-place lightweight insulating concrete for oven-dry unit weight and compressive strength.
- D. Water Test: Water tests will be performed on the completed lightweight insulating concrete deck to locate areas of ponding water. Correct any ponding that covers a nickel after 24 hours.

- E. Fastener Withdrawal Test: Base ply fastener pull tests will be performed 3 or more days following the application of the lightweight insulating concrete. Withdrawal resistance shall be minimum 40 lbs per fastener.

END OF SECTION

SECTION 04 21 00 - ARCHITECTURAL UNIT MASONRY

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Architectural masonry veneer construction consisting of the following:
 - 1. Face brick.
 - 2. Mortar for veneer.
 - 3. Ties and anchors.
 - 4. Embedded flashing.
 - 5. Miscellaneous masonry accessories.
- B. Products Installed but not Furnished under This Section:
 - 1. Steel lintels in masonry veneer.
- C. Related Sections:
 - 1. Division 04 Section "Concrete Unit Masonry" for CMU backup wall construction.
 - 2. Division 05 Section "Structural Steel Framing" for installing anchor sections of adjustable masonry anchors for connecting to structural steel frame.
 - 3. Division 05 Section "Metal Fabrications" for furnishing steel lintels and shelf angles for unit masonry.
 - 4. Division 07 Section "Thermal Insulation" □ for cavity wall insulation.
 - 5. Division 07 Section "Air Barriers□" for air barrier membrane applied to backup walls.
 - 6. Division 07 Section "Sheet Metal Flashing and Trim" for flashing and sheet metal related to masonry work.

1.2 PERFORMANCE REQUIREMENTS

- A. Provide 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.
 - 2. Determine net-area compressive strength of masonry by testing masonry prisms according to ASTM C 1314.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Indicate interface with adjacent materials.
- B. Shop Drawings:
 - 1. Detail interface of masonry with other adjacent and adjoining systems, including but not limited to, existing construction, air barriers, and flashings.
- C. Samples for Verification: For each type and color of the following:
 - 1. Face Brick, include at least 3 samples to indicate variations.
 - 2. Pigmented and colored-aggregate mortar. Make Samples using same sand and mortar ingredients to be used on Project.

- D. Qualification Data: For testing agency.
 - E. Material Certificates: For each type and size of the following:
 - 1. Masonry units.
 - a. Include material test reports substantiating compliance with requirements, produced within one year of submission.
 - b. For brick, include size-variation data verifying that actual range of sizes falls within specified tolerances.
 - c. For exposed brick, include test report for efflorescence according to ASTM C 67.
 - 2. Cementitious materials. Include brand, type, and name of manufacturer.
 - 3. Preblended, 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.
 - F. 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/C 109M 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.
 - G. 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.
 - H. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.
- 1.4 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. 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 typical wall area as shown on Drawings in accordance with Section 01 40 00 "Quality Control."

- a. Include a sealant-filled joint at least 16 inches long in mockup.
 - b. Include lower corner of window opening at upper corner of exterior wall mockup. Make opening approximately 12 inches wide by 16 inches high. Include flashing end dam.
 - c. Include through-wall flashing installed for a 24-inch length in corner of exterior wall mockup approximately 16 inches down from top of mockup, with a 12-inch length of flashing left exposed to view (omit masonry above half of flashing).
 - d. Include cmu backup wall, air barrier, veneer anchors,, flashing with fabricated end dams, cavity drainage material, and weep holes in exterior masonry-veneer wall mockup.
2. Clean exposed faces of mockups with masonry cleaner as indicated.
 3. Protect accepted mockups from the elements with weather-resistant membrane.
 4. Approval of mockups is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; and aesthetic qualities of workmanship.
 - a. Approval of mockups is also for other material and construction qualities specifically approved by Architect in writing.
 - b. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless such deviations are specifically approved by Architect in writing.
 5. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."
1. Include the following attendees at a minimum:
 - a. Owner
 - b. Superintendent
 - c. Subcontractor Foreman
 - d. Architect,
 - e. Air barrier and flashing subcontractors for tie-in, as appropriate.
 2. The following topics will need to be addressed along with normal pre-construction requirements:
 - a. Delivery and storage requirements;
 - b. Field mock-up requirements;
 - c. Factory Quality Control testing;
 - d. Field Quality Control testing;
 - e. Tie-in to adjacent materials;
 - f. Schedule.
- 1.5 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 preblended, dry mortar mix in moisture-resistant containers designed for use with dispensing silos. Store preblended, 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.

1.6 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.
 - 2. Where one wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches down face next to unconstructed wythe and hold cover 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 seven 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 MANUFACTURERS

- A. 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.

- B. 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.

2.2 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.

2.3 BRICK

- A. General: Provide shapes indicated and as follows, with exposed surfaces matching finish and color of exposed faces of adjacent units:
 - 1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
 - 2. Provide special shapes for applications where stretcher units cannot accommodate special conditions, including those at corners, movement joints, bond beams, sashes, and lintels.
 - 3. Provide special shapes for applications requiring brick of size, form, color, and texture on exposed surfaces that cannot be produced by sawing.
 - 4. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.
- B. Face Brick: ASTM C 216 or C652, Grade SW, Type FBS.
 - 1. Size (Actual Dimensions): Modular; 3-5/8 inches wide by 2-1/4 inches high by 7-5/8 inches long.
 - 2. Bond: Half running bond.
 - 3. Initial Rate of Absorption: Less than 30 g/30 sq. in. per minute when tested per ASTM C 67, and measured in the field and documented prior to installation.
 - 4. Efflorescence: Provide brick that has been tested according to ASTM C 67 and is rated "not effloresced."

2.4 MORTAR MATERIALS

- A. 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.
- B. Hydrated Lime: ASTM C 207, Type S.
- C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.
- D. Masonry Cement: ASTM C 91.
 - 1. Products: Subject to compliance with requirements, provide one of the following:

- a. Holcim (US) Inc.; White Mortamix Masonry Cement.
 - b. Lafarge North America Inc.; Trinity White Masonry Cement.
 - c. Lehigh Cement Company; Lehigh White Masonry Cement.
- E. Colored Cement Product: Packaged blend made from portland cement and hydrated lime or masonry cement and mortar pigments, all complying with specified requirements, and containing no other ingredients.
1. Colored Portland Cement-Lime Mix:
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) Holcim (US) Inc.; Rainbow Mortamix Custom Color Cement/Lime.
 - 2) Lafarge North America Inc.; Eaglebond Portland & Lime.
 - 3) Lehigh Cement Company; Lehigh Custom Color Portland/Lime Cement.
 2. Colored Masonry Cement:
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) Holcim (US) Inc.; Rainbow Mortamix Custom Color Masonry Cement.
 - 2) Lafarge North America Inc.; U.S. Cement Custom Color Masonry Cement.
 - 3) Lehigh Cement Company; Lehigh Custom Color Masonry Cement.
 3. Formulate blend as required to produce color indicated or, if not indicated, as selected from manufacturer's standard colors.
 4. Pigments shall not exceed 10 percent of portland cement by weight.
 5. Pigments shall not exceed 5 percent of masonry cement by weight.
- F. 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.
- G. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Euclid Chemical Company; Accelguard 80.
 - b. GCP Applied Technologies Inc.; Morset.
 - c. Sonneborn Products, BASF Construction Chemicals; Trimix-NCA.
- H. Water: Potable.
- 2.5 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. Mill-Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M; with ASTM A 641/A 641M, Class 1 coating.
 2. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M; with ASTM A 153/A 153M, Class B-2 coating.

3. Steel Sheet, Galvanized after Fabrication: ASTM A 1008/A 1008M, Commercial Steel, with ASTM A 153/A 153M, Class B coating.
 4. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Wire Ties, General: Unless otherwise indicated, size wire ties to extend at least halfway through veneer but with at least 5/8-inch cover on outside face.
- C. 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. Mill-galvanized wire may be used at interior walls unless otherwise indicated.
 2. Tie Section: Triangular-shaped wire tie, sized to extend within 1 inch of masonry face, made from 0.25-inch- diameter, hot-dip galvanized steel wire. Mill-galvanized wire may be used at interior walls unless otherwise indicated.
- D. Adjustable Masonry-Veneer Anchors:
1. General: 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:
 - a. Structural Performance Characteristics: Capable of withstanding a 100-lbf load in both tension and compression without deforming or developing play in excess of 0.05 inch.
 2. Products: Subject to compliance with requirements, provide the following:
 - a. Studs: Hohmann & Barnard, Inc.; HB-213-2X
 - b. Masonry and Concrete: Hohmann & Barnard, Inc.; HB-5213
 3. Fabricate sheet metal anchor sections and other sheet metal parts from 1.05-inch- thick steel sheet, galvanized after fabrication.
 4. Wire Ties: Triangular-, rectangular-, or T-shaped wire ties fabricated from 0.25-inch- diameter, hot-dip galvanized-steel wire unless otherwise indicated.
 5. Back Plate: 12 gauge
 6. Washers

2.6 EMBEDDED FLASHING MATERIALS

- A. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual" and Division 07 Section "Sheet Metal Flashing and Trim".
1. Stainless Steel: ASTM A 240/A 240M, Type 304, 0.025 inch (24 gage) thick.
 2. Fabricate continuous flashings in sections 96 inches long minimum, but not exceeding 12 feet. Provide splice plates and sealant at joints of formed, smooth metal flashing.
 3. Fabricate through-wall metal flashing embedded in masonry from stainless steel.
 4. Fabricate through-wall flashing with drip edge unless otherwise indicated. Fabricate by extending flashing 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.
- B. Flexible Flashing: Provide self-adhering rubberized asphalt flashings complying with Section 07 27 26 "Air Barriers" and the following:
1. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.
 2. Provide complete single source warranty with the air barrier system.

- C. Application: Unless otherwise indicated, use the following:
 - 1. Where flashing is indicated to receive counterflashing, use metal flashing.
 - 2. Where flashing is indicated to be turned down at or beyond the wall face, use metal flashing.
 - 3. Where flashing is partly exposed and is indicated to terminate at the wall face, use metal flashing.
 - 4. Where flashing is fully concealed, use flexible flashing, except use metal flashing at foundation sill and above openings.

- D. Solder and Sealants for Sheet Metal Flashings:
 - 1. Solder: As specified in Section 07 62 00 "Sheet Metal Flashing and Trim."
 - 2. Sealant: Silicone type at exposed conditions and butyl type at concealed conditions, as specified in Section 07 92 00 "Joint Sealants."

2.7 MISCELLANEOUS MASONRY ACCESSORIES

- A. Compressible Filler: Premolded 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. Cavity Drainage Material: Dovetail shaped, free-draining mesh, made from polymer strands that will not degrade within the wall cavity. Flat top material not acceptable.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Mason; ProNet Green-2.
 - b. Mortar Net Solutions; Mortar Net.
 - 2. Provide the following configuration:
 - a. Strips, 2-inch deep by 10 inches high, with dovetail shaped notches 7 inches deep that prevent clogging with mortar droppings.

- C. Weep/Vent Products: Use the following unless otherwise indicated:
 - 1. Cellular Plastic Weep/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth 1/8 inch less than depth of outer wythe, in color selected from manufacturer's standard.
 - a. Products: Subject to compliance with requirements, provide the following for locations other than at foundation sills:
 - 1) Mortar Net Solutions; CellVent.

2.8 MASONRY CLEANERS

- A. Proprietary Cleaner: Manufacturer's standard-strength non-acidic 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 cleaner manufacturer and manufacturer of masonry units being cleaned. Use product line which is formulated for color of brick specified.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Diedrich Technologies, Inc.
 - b. EaCo Chem, Inc.
 - c. ProSoCo, Inc.

2.9 MORTAR 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.
 - 2. Use portland cement-lime or masonry cement mortar unless otherwise indicated.
 - 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. Preblended, 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.
- C. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification. Provide Type N mortar for masonry veneer unless otherwise indicated.
- D. Pigmented Mortar: Use colored cement product or select and proportion pigments with other ingredients to produce color required. Do not add pigments to colored cement products.
 - 1. Pigments shall not exceed 10 percent of portland cement by weight.
 - 2. Pigments shall not exceed 5 percent of masonry cement by weight.
 - 3. Mix to match Architect's sample.
 - 4. Application: Unless otherwise instructed, use pigmented mortar for exposed mortar joints with the following units:
 - a. Decorative CMUs.
 - b. Face brick.

PART 3 - EXECUTION

3.1 PREPARATION AND COORDINATION - AIR BARRIER

- A. Coordinate work of this Section with installation of air barrier specified in Section 07 27 26 "Air Barriers."
 - 1. Before beginning work, inspect air barrier system to verify that air barrier installation is complete, sealed to embedded and penetrating items, and ready to receive work of this Section. Do not begin work prior to inspection of air barrier installation.
 - 2. As work progresses, tie-in and seal embedded and thru-wall flashings to air barrier system to create an air- and water-tight envelope.

3.2 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 and brick ledges are within tolerances specified.
 - 3. Verify that curtain walls, storefronts, and other items built into the work of this Section are in place and sealed air- and water-tight.
- B. Before installation, measure the Initial Rate of Absorption and document. Keep documentation for review during construction and at Project Closeout.

- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION, GENERAL

- A. Thickness: Build cavity walls to thickness shown.
- 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.
- D. 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.
- E. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested per ASTM C 67. Allow units to absorb water so they are damp but not wet at time of laying.

3.4 CAVITY WALL INSULATION

- A. Installing Cavity-Wall Insulation: Place small dabs of adhesive, spaced approximately 12 inches o.c. both ways, on inside face of insulation boards, or attach with plastic fasteners designed for this purpose. Fit courses of insulation between wall ties and other confining obstructions in cavity, with edges butted tightly both ways. Press units firmly against inside wythe of masonry or other construction as shown.
 - 1. Fill cracks and open gaps in insulation with crack sealer compatible with insulation and masonry.

3.5 LAYING MASONRY VENEER

- A. Lay out veneer 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 bond pattern indicated on Drawings; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
- C. Bond Pattern for Concealed Masonry: Lay concealed masonry 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. Keep cavities clean of mortar droppings and other materials during construction. Bevel beds away from cavity, to minimize mortar protrusions into cavity. Do not attempt to trowel or remove mortar fins protruding into cavity.

- E. 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, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.
- F. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- G. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

3.6 MORTAR BEDDING AND JOINTING

- A. 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.
- B. Lay hollow brick and CMUs with face shells fully bedded in mortar and with head joints of depth equal to bed joints. At starting course, fully bed entire units, including area under cells.
 - 1. At anchors and ties, fully bed units and fill cells with mortar as needed to fully embed anchors and ties in mortar.
- C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

3.7 ANCHORING MASONRY VENEERS

- A. Anchor masonry veneers to wall framing and concrete and masonry backup with masonry-veneer anchors to comply with the following requirements:
 - 1. Fasten screw-attached anchors through sheathing to wall framing and to concrete and masonry backup with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.
 - 2. Embed wire ties in masonry joints. Provide not less than 2 inches of air space between back of masonry veneer and face of sheathing.
 - 3. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
 - 4. Space anchors not more than 16 inches o.c. vertically and 16 inches o.c. horizontally. Install additional anchors within 12 inches of openings and at intervals, not exceeding 8 inches, around perimeter.
 - 5. Where fasteners penetrate air barrier, provide gasketed fasteners or take steps to maintain membrane continuity as instructed by air barrier manufacturer.

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 expansion joints as follows:
 - 1. Form open joint full depth of wythe and of width indicated, but not less than 3/8 inch width for installation of sealant and backer rod specified in Division 07 Section "Joint Sealants."

- C. 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 Division 07 Section "Joint Sealants," but not less than 3/8 inch.
 - 1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry.

3.9 FLASHING, WEEP HOLES, CAVITY DRAINAGE, AND VENTS

- A. General: Install weep holes and continuous embedded flashing in masonry at foundation sill, 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. Coordinate flashings with installation of air barrier membrane under Section 07 27 26. Utilize air barrier materials or materials compatible with air barrier.
- 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. Set flashing in bed of sealant or mastic in accordance with Division 07 for flashing at and below grade.
 - 3. At masonry-veneer walls, extend flashing through veneer, across air space behind veneer, and up face of sheathing at least 8 inches; with upper edge tucked under mastic tape and air barrier membrane, lapping at least 4 inches and secured by termination bar.
 - 4. At lintels and shelf angles, 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.
 - 5. Interlock end joints of sheet metal flashing by overlapping not less than 1-1/2 inches or as recommended by flashing manufacturer, and seal lap with elastomeric sealant complying with requirements in Division 07 Section "Joint Sealants" for application indicated.
 - 6. 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.
- C. Install receivers and nailers for flashing and other related construction where they are shown to be built into masonry.
- D. Install weep holes in head joints of first course of veneer masonry immediately above embedded flashing and as follows:
 - 1. Use specified weep/vent products to form weep holes.
 - 2. Space weep holes 24 inches o.c. unless otherwise indicated.
- E. Place cavity drainage material in cavities to comply with configuration requirements for cavity drainage material in "Miscellaneous Masonry Accessories" Article.

3.10 LOOSE LINTELS

- A. Install galvanized steel lintels as indicated.
- B. Provide lintels where shown and where openings of more than 12 inches for brick-size units are shown without structural steel or other supporting lintels.

- C. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated. Field cutting of lintels is allowed. Coat cut edges with galvanizing repair paint prior to installation.

3.11 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 comply with specified requirements shall be done at Contractor's expense.
- B. Inspections: Provide the following special inspections according to the "International Building Code."
 - 1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
- 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. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C 780.
- F. Mortar Test (Property Specification): For each mix provided, according to ASTM C 780. Test mortar for mortar air content and compressive strength.
- G. Prism Test: For each type of construction provided, according to ASTM C 1314 at 7 days and at 28 days.

3.12 REPAIRING AND POINTING

- 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.

3.13 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.
7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch 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.
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. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch.
5. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch from one masonry unit to the next.

3.14 CLEANING

A. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

B. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes.
2. Protect adjacent surfaces from contact with cleaner.
3. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
4. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
5. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.
6. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.
7. Application:
 - a. Clean from bottom up; prevent cleaning materials and rinse water from contacting non-cementitious materials.
 - b. Clean in accordance with manufacturer's instructions and recommendations, product data, and container label instructions.
 - c. Mix materials in strict accordance with manufacturer's instructions; do not dilute unless permitted by manufacturer.
 - d. Prevent overspray, wind drift, and splash onto surfaces not to be treated.

- e. No high pressure washers are permitted.
- f. Low pressure spray for wetting and rinsing is permitted. Pressure should be in the range of 400-1000 psi. Equipment should produce 6-8 gallons of water per minute using a 15-40 degree fan tip (no fan tip less than a 15 degree is allowed).
- g. No metal tools or wire brushes are allowed for cleaning of masonry. Use a waste piece of same masonry material for scraping of installed material.

END OF SECTION

SECTION 04 22 00 - CONCRETE UNIT MASONRY

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Concrete masonry units.
 - 2. Mortar and grout.
 - 3. Steel reinforcing.
 - 4. Masonry-joint reinforcement.
 - 5. Miscellaneous masonry accessories.
- B. Related Requirements:
 - 1. Section 04 21 00 "Architectural Unit Masonry" for face brick.

1.2 DEFINITIONS

- A. CMU(s): Concrete masonry unit(s).
- B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Show fabrication and installation details for the following:
 - 1. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars and for templates for layout of dowels for columns and pilasters. Comply with the fabrication tolerances of ACI 315, *Details and Detailing of Concrete Reinforcement*. □□ Show bar schedules, diagrams of bent bars, stirrup spacing, lateral ties and other arrangements and assemblies as required for fabrication and placement of reinforcement for unit masonry work.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Material Certificates: For each type and size of the following:
 - 1. Masonry units.
 - a. Include data on material properties.
 - b. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.
 - 2. Cementitious materials. Include name of manufacturer, brand name, and type.

3. Mortar admixtures.
4. Joint reinforcement.
5. Anchors, ties, and metal accessories.

C. 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/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91/C 91M for air content.
2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

D. 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 TMS 602/ACI 530.1/ASCE 6.

E. 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. Testing Agency Qualifications: Qualified according to ASTM C 1093 for testing indicated.

1.7 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 preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms 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.

1.8 FIELD 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 TMS 602/ACI 530.1/ASCE 6.
 - 1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.
- E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

2.2 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 TMS 602/ACI 530.1/ASCE 6.

2.3 UNIT MASONRY, GENERAL

- A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6 except as modified by requirements in the Contract Documents.
- B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work.

- C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.
 - 1. Fire-resistance-rated assembly designs are based on standard concrete masonry units; special fire-rated units are not required.

2.4 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, bonding, and other special conditions.
 - 2. Provide square-edged units for outside corners unless otherwise indicated.
- B. CMUs: ASTM C 90.
 - 1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2,150 psi.
 - 2. Density Classification: Lightweight.
 - 3. Size (Width): Manufactured to dimensions 3/8 inch less-than-nominal dimensions.
- C. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs matching adjacent CMUs in color, texture, and density classification, 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.

2.5 MORTAR AND GROUT MATERIALS

- A. Portland Cement: ASTM C 150/C 150M, Type I or II, except Type III may be used for cold-weather construction.
- B. Hydrated Lime: ASTM C 207, Type S.
- C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.
- D. Masonry Cement: ASTM C 91/C 91M.
- E. Mortar Cement: ASTM C 1329/C 1329M.
- F. Aggregate for Mortar: ASTM C 144.
- G. Aggregate for Grout: ASTM C 404.
- H. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.
- I. Water: Potable.

2.6 REINFORCEMENT

- A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M, Grade 60.

- B. Masonry-Joint Reinforcement, General: Ladder type complying with ASTM A 951/A 951M; mill galvanized for interior walls and hot-dip galvanized for exterior walls.

- 1. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units.

2.7 TIES AND ANCHORS

- A. General: Ties and anchors shall extend at least 1-1/2 inches into masonry but with at least a 5/8-inch cover on outside face.

- B. 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/A 82M, with ASTM A 153/A 153M, Class B-2 coating.
 - 2. Steel Sheet, Galvanized after Fabrication: ASTM A 1008/A 1008M, Commercial Steel, with ASTM A 153/A 153M, Class B coating.
 - 3. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

- C. 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 made from 1/4-inch- diameter, hot-dip galvanized steel wire.

- D. 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 0.105-inch- thick steel sheet, galvanized after fabrication.
 - 2. Tie Section: Triangular-shaped wire tie made from 1/4-inch- diameter, hot-dip galvanized steel wire. Mill-galvanized wire may be used at interior walls unless otherwise indicated.

- 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/A 153M.

- F. Post-Installed Anchors:

- 1. ICC Approval: Only anchors evaluated by the ICC Evaluation Service, Inc. (ICC-ES) with a published Evaluation Report specifically addressing anchorage to hollow or fully grouted concrete masonry shall be approved for use.
 - 2. Type:
 - a. Hollow Concrete Masonry: Anchors into or through hollow concrete masonry units shall be the chemical type used with a galvanized or stainless steel screen tube that allows the chemical adhesive to create a key within the hollow cell of the unit.
 - b. Fully Grouted Concrete Masonry: Anchors into fully grouted masonry shall be either chemical anchors or expansion anchors specifically approved by ICC-ES for use in fully-grouted concrete masonry.
 - 3. Finish:

- a. Interior Exposure: All anchors, nuts and washers for use in interior environments free of potential moisture shall be manufactured from carbon steel, zinc plated in accordance with Federal Specification QQ-Z-325C, Type II, Class 3.
- b. Exterior or Exposed Use: All anchors, nuts, and washers for use in exposed or potentially wet environments, or for attachment of exterior cladding materials shall be galvanized or stainless steel. Galvanized anchors, nuts and washers shall conform to ASTM A 153. Stainless steel anchors shall be manufactured from 300 series stainless steel and nuts and washers from 300 series or Type 18-8 stainless steel.

G. Manufacturers:

1. Subject to compliance with requirements, provide products of one of the following:
 - a. AA Wire Products Co.
 - b. Dur-O-Wall, Inc.
 - c. Hohmann & Barnard, Inc.
 - d. National Wire Products Corp.
 - e. Heckman Building Products

H. Finishes: Provide reinforcement, ties, and anchors specified in subsequent paragraphs that are made from materials or that have the finishes that comply with the below, depending on the finish specified, unless otherwise indicated.

1. Hot-Dip Galvanized Finishes
 - a. Joint Reinforcement, Wire Ties, Wire Anchors: ASTM A 153, (1.5 oz/ft²).
 - b. Sheet-metal Ties and Anchors: ASTM A 153, Class B.
 - c. Steel Plates and Bars: ASTM A 123 or ASTM A 153, Class B.

2.8 MISCELLANEOUS MASONRY ACCESSORIES

- A. Compressible Filler: Premolded 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. Bond-Breaker Strips: Asphalt-saturated felt complying with ASTM D 226/D 226M, Type I (No. 15 asphalt felt).

2.9 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. Limit cementitious materials in mortar for exterior and reinforced masonry to portland cement and lime.
 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. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated.
 1. For masonry below grade or in contact with earth, use Type M or S.
 2. For reinforced masonry, use Type S.

3. For exterior, above-grade, load-bearing and nonload-bearing walls and parapet walls; for interior load-bearing walls; for interior nonload-bearing partitions; and for other applications where another type is not indicated, use Type N.
- C. 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 TMS 602/ACI 530.1/ASCE 6 for dimensions of grout spaces and pour height.
 2. Proportion grout in accordance with ASTM C 476, for a 28-day compressive strength of not less than 2,000 psi.
 3. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143/C 143M.

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. Verify that slabs and foundations are within tolerances specified.
 2. Verify that reinforcing dowels are properly placed.
 3. Verify that substrates are free of substances that would impair mortar bond.
- B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping.
- 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 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.
- D. Cleaning Reinforcing: Before placing, remove loose rust, ice and other coatings from reinforcing.
- E. Mixing Mortar and Grout: Comply with the requirements of ACI 530.1/ASCE 6/TMS 602.
- F. The masonry contractor shall install all accessory items that are required in the work and supplied by others, including: bolts, nailing blocks, inserts, anchors, flashing, steel lintels, expansion joints, conduits, cast-stone trim, hollow-metal door frames, etc.

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 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.
7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch.

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 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 CONSTRUCTION STABILITY

- A. Design, provide and install bracing that will assure stability of masonry during construction.

3.5 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; do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.

- C. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
1. Fill in space between hollow metal frames and masonry solidly with mortar, unless otherwise indicated.
 2. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath in the joint below and rod mortar or grout into core, unless detailed otherwise.
 3. Fill cores in hollow concrete masonry units with grout to supporting beam or slab below under bearing plates, beams, lintels, posts and similar items, unless otherwise indicated.
 4. Install compressible filler in joint between top of partition and underside of structure above.
 5. Fasten partition top anchors to structure above. Install in accordance with details on Drawings.
 6. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Section 07 84 13 "Penetration Firestopping."

3.6 MORTAR BEDDING AND JOINTING

- A. Lay hollow CMUs as follows:
1. Bed face shells in mortar and make head joints of depth equal to bed joints.
 2. Bed webs in mortar in all courses of piers, columns, and pilasters.
 3. Bed webs in mortar in grouted masonry, including starting course on footings.
 4. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.
- B. Lay solid masonry units and fully-grouted hollow CMU with completely filled bed and head joint as follows:
1. Butter ends with sufficient mortar to fill head joints and shove into place. Do not furrow bed joints or slush head joints.
- C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
- D. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.
- E. Cut joints flush where indicated to receive waterproofing unless otherwise indicated.
- F. Do not fill horizontal joints between top of masonry partitions and underside of concrete or steel construction with mortar unless specifically shown on the drawings. If not shown otherwise, provide 1" clear joint to be filled with caulk. Keep movement joints clean of all mortar and debris.

3.7 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.
 3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings.

- 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.
- F. Reinforce walls with continuous horizontal joint reinforcing unless specifically noted to be omitted.
- G. Reinforce masonry openings greater than 1'-0" wide, with horizontal joint reinforcement placed in two horizontal joints approximately 8 inches apart, immediately above the lintel and immediately below the sill. Extend reinforcement a minimum of 2'-0" beyond jambs of the opening except at control joints. Horizontal joint reinforcement interrupted by the jamb of an opening shall have the cross rod or side rod bent and hooked at the jamb. Provide an additional rectangular adjustable tie at the jamb for each joint not containing the normal horizontal reinforcing unit.
- H. Provide reinforcement at openings in addition to other specified wall reinforcement.

3.8 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 1/2 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.

3.9 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. Install temporary foam-plastic filler in head joints, and remove filler when unit masonry is complete for application of sealant.
 - 2. Place control joints such that the panel length to height ratio does not exceed 1.5 and that the maximum panel length does not exceed 25 feet. Additional joints shall be placed where abrupt changes in wall section occur.

3.10 LINTELS

- A. Provide masonry lintels where shown and where openings of more than 24 inches are shown without structural steel or other supporting lintels.
 - 1. For hollow concrete masonry unit walls, use specially formed U-shaped lintel units with reinforcement bars placed as shown filled with coarse grout.

- B. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.

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.
 - 3. Formwork shall be designed and shop drawings prepared by a registered professional engineer in the state where the project is located.
- B. Placing Reinforcement: Comply with requirements in TMS 602/ACI 530.1/ASCE 6.
 - 1. General: Clean reinforcement of loose rust, mill scale, earth, ice or other materials which will reduce bond to mortar or grout. Do not use reinforcement bars with kinks or bends not shown on drawings or final shop drawings, or bars with reduced cross-section due to excessive rusting or other causes.
 - 2. Position reinforcement accurately at the spacing indicated. Prior to grouting, support and secure vertical bars against displacement. Vertical bars shall be held in position at the top and bottom and at intervals not exceeding 8'-0" with a minimum clearance of 1/4 inch if fine grout is used or 1/2 inch if coarse grout is used from the face of the masonry and not less than one bar diameter or 1 inch (whichever is greater) between adjacent bars.
 - 3. For columns, piers and pilasters, provide a clear distance between vertical bars as indicated, but not less than 1-1/2 times the nominal bar diameter or 1-1/2 inches, whichever is greater. Provide lateral ties as indicated.
 - 4. All dowels shall be grouted into a cell even if the dowel is in an adjacent cell to the vertical steel. Unless detailed otherwise on the drawings, dowels shall be the same size and number as the vertical steel. Unless noted otherwise provide a lap length of dowels to vertical reinforcement equal to 50 times the nominal dowel diameter.
 - 5. All horizontal reinforcing steel shall be placed in continuous bond beam or lintel block units and shall be solidly grouted in place. Maintain a minimum of one bar diameter or 1 inch (whichever is greater) clearance between adjacent bars and a minimum of 1/4 inch clearance if fine grout is used or 1/2 inch if coarse grout is used from the face of the masonry. Horizontal reinforcement may be placed as the masonry work progresses.
 - 6. Splice reinforcement bars where shown; do not splice at other points unless acceptable to the Engineer. Where splices occur, adjacent splices shall be staggered so that no more than 25% of the total number of bars is spliced at any one point with a minimum stagger between splices in adjacent bars of at least the lap length. Provide lapped splices, unless otherwise indicated. In splicing vertical bars or attaching to dowels, lap ends, place in contact and wire tie. Minimum lap splice length shall be 50 bar diameters unless indicated otherwise.
 - 7. Where reinforcement is prefabricated into cage units before placing, fabricate units with vertical reinforcement bars and lateral ties of the size and spacing indicated.
- 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 TMS 602/ACI 530.1/ASCE 6 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. Where detailed, grout in reinforced masonry walls, columns, and pilasters. Fully grout vertical cells of concrete masonry containing steel reinforcement.
 4. Place grout in lintels or beams over openings in one continuous pour.
 5. Where bond beam occurs more than one course below top of pour and vertically reinforced cells are present above the bond beam, fill bond beam course to within 1-1/2 inches of the top of the bond beam.
 6. When more than one pour is required to complete a given section of masonry, extend reinforcement beyond masonry as required for splicing. Pour grout to within 1-1/2 inches of top course of first pour. After grouted masonry is cured, lay masonry units and place reinforcement for second pour section before grouting. Repeat sequence if more pours are required.
- D. Intersecting and Abutting Walls: Unless vertical expansion or control joints are shown at juncture, provide same type of bonding specified for structural bonding between wythes and space as follows:
1. Provide individual metal ties at not more than 16 inches o.c. vertically.
 2. Provide continuity with horizontal joint reinforcement using prefabricated "T" units.

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 comply with specified requirements shall be done at Contractor's expense.
- B. Inspections: Special inspections according to Level B in TMS 402/ACI 530/ASCE 5.
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. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C 780.
- G. Mortar Test (Property Specification): For each mix provided, according to ASTM C 780. Test mortar for compressive strength.
- H. Grout Test (Compressive Strength): For each mix provided, according to ASTM C 1019.
- I. 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; prior to cleaning, protect adjacent materials and finishes from exposure to cleaning solutions, or test cleaning solutions on materials to verify discoloration or etching does not occur.
 - 3. Protect adjacent surfaces from contact with cleaner.
 - 4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
 - 5. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.

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.

END OF SECTION

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.
- B. Related Sections:
 - 1. Section 01 4523 "Testing and Inspection Services".
 - 2. Section 05 3113 "Steel Floor Decking".
 - 3. Section 05 3123 "Steel Roof Decking".
 - 4. Section 05 5000 "Metal Fabrications".

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. Delegated Design: Prepare submittal documents including connection design calculations and drawings signed and sealed by registered design professional, licensed in state where project is located, employed by the steel fabricator.
- B. Design all structural steel framing connections complying with specified performance:
1. Load Capacity: Resist loads indicated on drawings or resist full capacity of supported framing member if reaction not indicated. Account for connection and member loads and eccentricities.
 - a. Request additional design criteria when necessary to complete connection design.
 2. Configuration: Design and detail all connections for each member size, steel grade and connection type to resist the loads and reactions indicated on the drawings or specified herein. Use details consistent with details shown on drawings, supplementing where necessary. The details shown on drawings are conceptual and do not indicate the required weld sizes or number of bolts unless specifically noted. Use rational engineering design and standard practice in detailing, accounting for all loads and eccentricities in both the connection and the members. Promptly notify the design professional in charge of any location where the connection design criteria is not clearly indicated. The design of all connections is subject to the review and acceptance of the design professional in charge. Submit structural calculations prepared and sealed by a qualified engineer registered in the state where the project is located. Submit calculations for review before preparation of detail drawings.
- 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.

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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 with a minimum of (5) years of experience that participates in the AISC Quality Certification Program for Category I or higher structures and is designated and is designated an AISC-Certified Plant, Category STD. An otherwise qualified fabricator who is not a member of the AISC Quality Certification Program will be accepted if satisfactory evidence of qualifications is submitted prior to award of Contract. For non-certified fabricators, Contractor shall submit a resume describing plant size, equipment quality control procedures and personnel, and experience on comparable work in the last five (5) years.
- 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.

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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 3000.

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

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.

2.8 GALVANIZING

- A. 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.
 - 3. Exposed exterior structural steel.

2.9 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.

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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 4523.
- 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

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.
 - a. Extended ends.
 - b. Ceiling extensions.
 - c. Bearing plates.
 - d. Bridging.
 - e. Side wall anchors.
- B. Related Requirements:
1. Section 03 3000 "Cast-in-Place Concrete".
 2. Section 01 4523 "Testing and Inspection Services"
 3. Section 04 2000 "Unit Masonry".
 4. Section 05 1200 "Structural Steel Framing".
 5. Section 05 3123 "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.
1. AWS D1.1 Structural Welding Code
 2. SJI "Standard Specification Load Tables and Weight Tables for Steel Joists and Joist Girders".
 3. SDI "Design Manual for Composite Decks, Form Decks, Roof Decks, Cellular Metal Floor Deck with Electrical Distribution".
 4. SSPC Steel Structures Painting Council 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 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.

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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.
- 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."
 - 1. Manufacturer's responsibilities include providing professional engineering services for designing special joists to comply with performance requirements.
- B. 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.
 - 1. Use ASD; data are given at service-load level.
 - 2. Design special joists to withstand design loads with live-load deflections no greater than the following:
 - a. Floor Joists: Vertical deflection of 1/360 of the span.
 - b. Roof Joists: Vertical deflection of 1/360 of the span.
- B. 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.
 - 1. 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.
 - 1. 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 1.5 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
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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.

1. Before installation, splice joists delivered to Project site in more than one piece.
 2. Space, adjust, and align joists accurately in location before permanently fastening.
 3. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.
 4. Delay rigidly connecting bottom-chord extensions to columns or supports until dead loads are applied.
- C. 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.
- D. 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.
- E. 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 4523.

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.
1. Clean and prepare surfaces by hand-tool cleaning according to SSPC-SP 2, or power-tool cleaning according to SSPC-SP 3.
 2. Apply a compatible primer of same type as primer used on adjacent surfaces.
- C. 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

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 4523 "Structural Testing and Inspection Services"
 - 2. Section 05 12 00 "Structural Steel Framing".
 - 3. Section 05 50 00 "Metal Fabrications".

1.3 REFERENCES

- A. Comply with applicable provisions of the following specifications and documents. The latest adopted edition of all standard 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 4523.
- 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. Marlyn 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.
- 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, G90 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, G90 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.

STEEL ROOF DECKING

- 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 4523.
- 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

SECTION 05 40 00 - COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Cold-formed metal framing for the following applications:
 - 1. Interior non-load-bearing wall framing exceeding height limitations of standard, nonstructural metal framing.
- B. Related Requirements:
 - 1. Section 09 22 16 "Non-Structural Metal Framing" for standard, interior non-load-bearing, metal-stud framing, with height limitations and ceiling-suspension assemblies.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
 - 1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
 - 2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

1.3 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of code-compliance certification for studs and tracks.
- B. Product Test Reports: For each listed product, from a qualified testing agency.
 - 1. Steel sheet.
 - 2. Expansion anchors.
 - 3. Mechanical fasteners.
 - 4. Vertical deflection clips.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide products by one of the following:
 - 1. CEMCO, www.cemcosteel.com.
 - 2. ClarkDietrich Metal Framing; www.clarkdietrich.com.
 - 3. MarinoWare; www.marinoware.com.
 - 4. SCAFCO Corporation; www.scafco.com.

2.2 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide cold-formed steel framing capable of withstanding design loads within limits and under conditions indicated.
 - 1. Design interior non-load-bearing wall framing to withstand a horizontal load of 5 lbs/sq ft without deflections greater than $l/240$ for walls with gypsum board finishes, and $l/360$ for walls with tile, stone, or plaster finishes.
 - 2. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:
 - a. Upward and downward movement of $l/300$.
- B. Cold-Formed Steel Framing Standards: Unless more stringent requirements are indicated, framing shall comply with AISI S100, AISI S200, and the following:
 - 1. Wall Studs: AISI S211.
 - 2. Headers: AISI S212.
- C. Fire-Resistance Ratings: Where metal framing is a part of a fire rated assembly, comply with ASTM E119; 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 acceptable to authorities having jurisdiction.

2.3 COLD-FORMED STEEL FRAMING MATERIALS

- A. Steel Sheet: ASTM A1003, Structural Grade, Type H, metallic coated, Grade ST33H; or ASTM A653, Grade 33, unless higher grade is required to meet performance requirements.
 - 1. Coating: G60.

2.4 INTERIOR NON-LOAD-BEARING WALL FRAMING

- A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: 0.0329 inch (20 gage).
 - 2. Flange Width: 1-3/8 inches.
- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: Matching steel studs.
 - 2. Flange Width: 1-1/4 inches.
- C. Single Deflection Track: Manufacturer's 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, and as follows:
 - 1. Minimum Base-Metal Thickness: 0.0329 inch (20 gage).
 - 2. Flange Width: 1 inch plus the design gap for one-story structures and 1 inch plus twice the design gap for other applications.

2.5 FRAMING ACCESSORIES

- A. Fabricate steel-framing accessories from same type, grade and coating designation used for framing members.
- B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:
 - 1. Supplementary framing.
 - 2. Bracing, bridging, and solid blocking.
 - 3. Web stiffeners.
 - 4. End clips.
 - 5. Gusset plates.
 - 6. Stud kickers and knee braces.
 - 7. Hole-reinforcing plates.
 - 8. Backer plates.

2.6 ANCHORS, CLIPS, AND FASTENERS

- A. Steel Shapes and Clips: ASTM A36, zinc coated by hot-dip process according to ASTM A123.
- B. Post-Installed Anchors: Fastener systems with bolts of same basic metal as fastened metal, if visible, unless otherwise indicated; with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01 or ICC-ES AC193 as appropriate for the substrate.
 - 1. Uses: Securing cold-formed steel framing to structure.
 - 2. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941, Class Fe/Zn 5, unless otherwise indicated.
- C. Mechanical Fasteners: ASTM C1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.

2.7 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: ASTM A780, MIL-P-21035B or SSPC-Paint 20.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, conditions, and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

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 of these materials as needed to complete installation of cold-formed framing without reducing thickness of fire-resistive materials below that required to obtain fire-resistance ratings indicated. Protect remaining fire-resistive materials from damage.

3.3 INSTALLATION, GENERAL

- A. Install cold-formed steel framing according to AISI S200, AISI S202, and manufacturer's written instructions unless more stringent requirements are indicated.
- B. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.
 - 1. Cut framing members by sawing or shearing; do not torch cut.
 - 2. Fasten cold-formed steel framing members by welding or screw fastening. Wire tying of framing members is not permitted.
 - a. Locate mechanical fasteners, install according to Shop Drawings, and comply with requirements for spacing, edge distances, and screw penetration.
- C. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.
- D. Install temporary bracing and supports to secure framing and support loads equal to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.
- E. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.
- F. Install acoustical insulation in framing-assembly members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.
- G. Fasten hole-reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.

3.4 INTERIOR NON-LOAD-BEARING WALL INSTALLATION

- A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure.
- B. Fasten both flanges of studs to bottom track unless otherwise indicated. Space studs as follows:
 - 1. Stud Spacing: As indicated on Drawings, but not greater than 16 inches oc.
- C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.
- D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
 - 1. Install single deep-leg deflection tracks and anchor to building structure.

- E. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches of single deflection track.
- F. Install horizontal bridging where indicated on Drawings
- G. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.5 ERECTION TOLERANCES

- A. Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
 - 1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.6 REPAIRS AND PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A780/A780M and manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 05 50 00 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Steel framing and supports for applications where framing and supports are not specified in other Sections.
 - 2. Metal ladders.
 - 3. Metal bollards.
- B. Products furnished, but not installed, under this Section include the following:
 - 1. Loose steel lintels.

1.2 ACTION SUBMITTALS

- A. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.
- B. Delegated-Design Submittal: For items accompanied with design criteria or performance requirements, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements."
- B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 METALS

- A. Metal Surfaces, General: 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.
- B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- C. Steel Tubing: ASTM A 500/A 500M, cold-formed steel tubing.
- D. Steel Pipe: ASTM A 53/A 53M, Standard Weight unless otherwise indicated.

2.3 FASTENERS

- A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
- B. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.
- C. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.
 - 1. 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. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

2.4 MISCELLANEOUS MATERIALS

- A. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
- B. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.
- D. Concrete: Comply with requirements in Section 03 30 00 "Cast-in-Place Concrete" for normal-weight, air-entrained, concrete with a minimum 28-day compressive strength of 3000 psi.

2.5 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Use connections that maintain structural value of joined pieces.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges. Remove sharp or rough areas on exposed surfaces.
- C. 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.
- D. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Locate joints where least conspicuous.
- E. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

- F. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors not less than 8 inches from ends and corners of units and 24 inches o.c.

2.6 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- B. 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.

2.7 METAL LADDERS

- A. General:
 - 1. Comply with ANSI A14.3.
 - 2. For elevator pit ladders, comply with ASME A17.1/CSA B44.
- B. Steel Ladders:
 - 1. Space siderails 18 inches apart unless otherwise indicated.
 - 2. Siderails: Continuous, 1/2-by-2-1/2-inch steel flat bars, with eased edges.
 - 3. Rungs: 3/4-inch- diameter steel bars.
 - 4. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
 - 5. Provide nonslip surfaces on top of each rung by coating with abrasive material metallurgically bonded to rung.
 - 6. Support each ladder at top and bottom and not more than 60 inches o.c. with welded or bolted steel brackets.
 - 7. Provide platforms as indicated, fabricated from welded or pressure-locked steel bar grating, supported by steel angles. Limit openings in gratings to no more than 1/2 inch in least dimension.
 - 8. Galvanize exterior ladders, including brackets.
 - 9. Prime interior ladders, including brackets and fasteners, with universal primer.

2.8 METAL BOLLARDS

- A. Fabricate metal bollards from Schedule 40 steel pipe.
- B. Fabricate sleeves for removable bollards from Schedule 40 steel pipe or 1/4-inch wall thickness steel tubing with inside diameter approximately 1/8 inch larger than outside diameter of bollards. Match drill sleeve and bollard for 3/4 inch steel machine bolt.
- C. Fabricate surface-mounted bollards with 3/8 inch thick steel baseplates for bolting to concrete slab. Drill baseplates at all four corners for 3/4 inch anchor bolts.
 - 1. Where bollards are to be anchored to sloping concrete slabs, angle baseplates for plumb alignment of bollards.
- D. Galvanize bollards.

2.9 LOOSE STEEL LINTELS

- A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated.
- B. Galvanize loose steel lintels.

2.10 FINISHES, GENERAL

- A. Finish metal fabrications after assembly.

2.11 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize indicated items to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.
 - 1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
- B. 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.
 - 1. Shop prime with universal shop primer.
- C. Preparation for Shop Priming: Prepare surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
- D. Shop Priming: Apply shop primer to 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 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: Comply with the following requirements:
 - 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.

- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.
- B. Anchor miscellaneous supports securely to, and rigidly brace from, building structure.

3.3 INSTALLING METAL 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. Anchor bollards in concrete in formed or core-drilled holes. Center and align bollards in holes 3 inches above bottom of excavation. Place concrete and vibrate or tamp for consolidation. Support and brace bollards in position until concrete has cured.
- C. Anchor sleeves for removable bollards in formed or core-drilled holes. Center and align sleeves in holes 3 inches above bottom of excavation. Place concrete and vibrate or tamp for consolidation. Support and brace sleeves in position until concrete has cured.
- D. Place removable bollards in sleeves and secure with 3/4 inch machine bolts and nuts. After tightening nuts, drill holes in bolts for inserting padlocks. Owner furnishes padlocks.
- E. Fill bollards solidly with concrete, mounding top surface to shed water.
 - 1. Do not fill removable bollards with concrete.

3.4 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Touchup uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

END OF SECTION

SECTION 06 10 00 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Wood blocking and nailers.
 2. Rooftop cants, nailers, curbs, and equipment bases.
 3. Plywood backing panels.

1.2 DEFINITIONS

- A. Boards or Strips: Lumber of less than 2 inches nominal size in least dimension.
- B. Dimension Lumber: Lumber of 2 inches nominal or greater size but less than 5 inches nominal size in least dimension.
- C. Lumber grading agencies, and the abbreviations used to reference them, include the following:
1. NeLMA: Northeastern Lumber Manufacturers' Association.
 2. NLGA: National Lumber Grades Authority.
 3. RIS: Redwood Inspection Service.
 4. SPIB: The Southern Pine Inspection Bureau.
 5. WCLIB: West Coast Lumber Inspection Bureau.
 6. WWPA: Western Wood Products Association.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
 2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
 3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5664.
 4. Include copies of warranties from chemical treatment manufacturers for each type of treatment.
 5. For fasteners securing wood nailers, curbs and equipment bases to the roof, include data showing compliance with specified requirements.

1.4 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.
- B. Evaluation Reports: For the following, from ICC-ES:
 - 1. Wood-preservative-treated wood.
 - 2. Fire-retardant-treated wood.

1.5 QUALITY ASSURANCE

- A. 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 lumber flat with spacers beneath and between each bundle to provide air circulation. Protect lumber from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
 - 1. Factory mark each piece of lumber with grade stamp of grading agency.
 - 2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece.
 - 3. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
 - 4. Provide dressed lumber, S4S, unless otherwise indicated.
 - 5. Maximum Moisture Content of Lumber: 19 percent unless otherwise indicated.
- B. Plywood: DOC PS 1 Exposure 1.
 - 1. Thickness: As needed to comply with requirements, but not less than 1/2 inch.
 - 2. Factory mark panels to indicate compliance with applicable standard.
 - 3. Maximum Moisture Content of Plywood: 15 percent unless otherwise indicated.

2.2 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
- B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame spread index of 25 or less when tested according to ASTM E 84, 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 beyond the centerline of the burners at any time during the test.
 - 1. Use treatment that does not promote corrosion of metal fasteners.
 - 2. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity.
 - 3. Design Value Adjustment Factors: Treated lumber shall be tested according ASTM D 5664 and design value adjustment factors shall be calculated according to ASTM D 6841.
- C. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Kiln-dry plywood after treatment to a maximum moisture content of 15 percent.
- D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.

2.3 WOOD-PRESERVATIVE-TREATED LUMBER

- A. Preservative Treatment by Pressure Process: AWPA 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. Do not use inorganic boron (SBX) for sill plates.
 - 2. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.
- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.
- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

2.4 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
 - 1. Blocking and nailers.
 - 2. Rooftop nailers, curbs, and equipment bases.
 - 3. Cants.
- B. Species: Provide miscellaneous lumber of one of the following species:
 - 1. Mixed southern pine or southern pine; SPIB.

2. Eastern softwoods; NeLMA.
3. Northern species; NLGA.
4. Western woods; WCLIB or WWPA.

- C. For items of dimension lumber size, provide Construction or No. 2 grade lumber.
- D. For concealed boards, provide No. 3 or better grade lumber.
- E. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.
- F. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

2.5 PLYWOOD BACKING PANELS

- A. Equipment Backing Panels: DOC PS 1, Exterior, AC, fire-retardant treated, in thickness indicated or, if not indicated, not less than 3/4-inch nominal thickness.
 1. At fire-rated walls, install board over wall board indicated as part of the fire-rated assembly.
 2. In MDF and IDF closets provide a 4' x 8' painted 3/4" plywood for telephone punch down blocks and video equipment.
 3. Where boards are indicated as full floor-to-ceiling height, install with long edge of board parallel to studs.
 4. Install adjacent boards without gaps.

2.6 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
 1. Type: 304 stainless steel, unless otherwise indicated.
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: NES NER-272.
- D. Wood Screws: ASME B18.6.1.
- E. Lag Bolts: ASME B18.2.1.
- F. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.
- G. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry assemblies and equal to four times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.
 1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.

2. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2.

2.7 MISCELLANEOUS MATERIALS

- A. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, rubberized-asphalt compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch.
- B. Adhesives for Gluing Furring to Concrete or Masonry: Formulation complying with ASTM D3498 that is approved for use indicated by adhesive manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.
- B. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant treated plywood backing panels with classification marking of testing agency exposed to view.
- C. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
- D. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- E. Comply with AWWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.
 1. Use inorganic boron for items that are continuously protected from liquid water.
 2. Use copper naphthenate for items not continuously protected from liquid water.
- F. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.
- G. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.
 2. Applicable FM and SPRI ES-1 requirements.

3.2 WOOD FRAMING AND BLOCKING INSTALLATION

- A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

- B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.
- C. Where wood-preserved-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

3.3 ROOF NAILER INSTALLATION

- A. Install wood nailers at perimeter of the entire roof and around such other roof projections and penetrations as specified in accordance with FM DS 1-49 securement requirements.
- B. 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 DS 1-49 requirements.
- C. Offset ends of stacked nailers a minimum of 6 inches.

3.4 PROTECTION

- A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

3.5 TREATMENT SCHEDULE

- A. Unless indicated otherwise, provide treatment of rough carpentry items as follows:
 - 1. Fire-Retardant Treatment:
 - a. All rough carpentry items not indicated to be preservative treated.
 - 1) Concealed members not required to be fire-retardant treated by the authorities having jurisdiction at the site of the Work may be untreated.
 - 2. Preservative Treatment:
 - a. Nailers, cants, curbs, and equipment bases in connection with roofing.
 - b. Blocking and nailers in connection with air barriers and waterproofing.

END OF SECTION

SECTION 06 10 02 – ROOFING ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Installation of wood nailers at perimeters of roof addition as indicated on the drawings.
- B. Replacement of wood nailers at perimeter of existing roofing

1.2 RELATED SECTIONS

- A. 02 40 00 - Minor Demolition and Renovation Work.
- B. 07 22 00 - Roof and Deck Insulation.
- C. 07 41 00 - Standing Seam Metal Roofing.
- D. 07 62 00 - Sheet Metal Flashing and Trim.

1.3 QUALITY ASSURANCE

- A. Provide sufficient workmen and supervisors who shall be present at all times during execution of this portion of the work and who shall be thoroughly familiar with the type of construction involved and the materials and techniques specified.
- B. All work shall conform to pertinent standards.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store all materials up, off the ground and cover with a weatherproof covering anchored sufficiently so as to resist wind blow-off.
- B. Keep all materials clearly identified with all grade marks legible. Keep all damaged material clearly identified as damaged and store separately to prevent its inadvertent use.
- C. Do not allow installation of damaged or otherwise non-complying material.
- D. In the event of damage, immediately make all necessary repairs and replacements to the approval of Owner and at no additional cost to Owner.

PART 2 - PRODUCTS

2.1 NEW ROOF ADDITION MATERIALS

- A. Wood Members, Nailers, and Blocking: Pressure preservative treated in accordance with AWPB LP-2 using Wolman Salts (Tanalith) and retaining 0.25 pounds salt per cubic foot wood. Preservatives shall be compatible with roof membrane.

- B. Lumber: Noncombustible Standard Grade Fir or No. 2 Southern Yellow Pine bearing UL label; complying with American Lumber Standards of manufacturer's association under whose rules lumber is produced; size minimum 2 X 6 (1-1/2-inch by 5-1/2-inches), nominal, or size to replace existing or as needed to suit application.
- C. Plywood: Minimum 3/4-inch APA pressure-treated exterior-rated sheathing, EXP 1 or "CDX", bearing APA trademark.
- D. Fasteners: Reference Section 02 40 00.

2.2 EXISTING ROOF OVERLAY MATERIALS

- A. Wood Members, Nailers, and Blocking: Pressure preservative treated in accordance with AWPB LP-2 using Wolman Salts (Tanalith) and retaining 0.25 pounds salt per cubic foot wood. Preservatives shall be compatible with roof membrane.
- B. Lumber: Noncombustible Standard Grade Fir or No. 2 Southern Yellow Pine bearing UL label; complying with American Lumber Standards of manufacturer's association under whose rules lumber is produced; size minimum 2 X 6 (1-1/2-inch by 5-1/2-inches), nominal, or size to replace existing or as needed to suit application.
- C. Fasteners: Reference Section 02 40 00
- D. Contractor to take care in the removal of the existing roofing, so the existing blocking can be reused for the roof overlay scope of work. If roof blocking is found damaged or deficient, the Contractor to provide blocking replacement as needed:

PART 3 - Treated 2" X 8" Perimeter Wood Nailers, Include 200 linear ft. in base bid for each school (Francone and Owens).

PART 4 - Treated 2" X 6" Perimeter Wood Nailers, Include 200 linear ft. in base bid for each school (Francone and Owens).

PART 5 - Treated 2" X 4" Perimeter Wood Nailers, Include 200 linear ft. in base bid for each school (Francone and Owens).

PART 6 - Treated 2" X 10" Perimeter Wood Nailers, Provide 200 linear ft. in base bid for each school (Francone and Owens).

PART 7 - EXECUTION

7.1 WOOD NAILERS

- A. Replace wood nailers at curbs with new wood nailers and curbs. Wood blocking shall be attached through the underlying roof deck fastened to the steel below and shall be installed flush with the existing lightweight insulating concrete deck, no exceptions. Wood blocking on the details is for reference only and may not represent the total amount of wood blocking needed for the height of the lightweight concrete deck.

- B. Install combination of wood nailers, shims, and sheathing to match height of new insulation layer at respective locations.
- C. Secure 2X base wood nailer into structure and/or substrate for anchorage of cleats and/or fascias of sheet metal fabrications, width as necessary to extend beyond horizontal flange of sheet metal fabrication.
- D. Clean and prepare existing surfaces to receive wood nailers and curbs.
- E. Install 2 X 6 wood nailer, minimum, as base wood nailer at perimeters.
- F. Install wood nailers and curbs continuously with 1/4-inch gap between each section. Set level and true. Pre-drill wood nailers prior to attachment. Countersink fastener in base wood nailer so that washer and head of fastener or nut are recessed below top of wood nailer.
- G. Securely fasten wood nailer to structure with appropriate fasteners to resist minimum 175 pounds per linear foot force in any direction and spaced 12-inches on-center. Use of powder-actuated fasteners is prohibited. Place a fastener within 3-inches of each end of each section of wood blocking.
- H. Secure wood nailers to concrete substrate with appropriate fasteners spaced 24-inches on-center. Secure wood nailer with a minimum of two fasteners per nailer.
- I. Secure wood nailers to metal substrate with screws spaced 12-inches on-center, 6-inches on-center, 10 foot from each corner.
- J. Secure wood nailers to wood substrate using nails 24-inches on-center, staggered. Install nails on an angle.
- K. Secure wood nailers with self-tapping steel fastener to structural steel with self-drilling screw or through-bolt spaced 12-inches on-center.
- L. If attaching wood nailer to concrete masonry block or masonry, install stainless steel threaded rod spaced 12-inches on-center in fully grouted cell/core of masonry.
- M. Stagger joints in subsequent layers of wood nailers from joints in underlying layer of wood nailers a minimum of 12-inches.
- N. Install wood nailers so that ends and sides of adjoining nailers are aligned to form right angles (nominal) at corners.
- O. Weave ends of subsequent layers of wood nailers at corners so that ends of nailers do not align.
- P. Reduce fastener spacing 50 percent at a distance of 10 feet from each corner.
- Q. Secure new wood nailer to existing wood nailer or curb when increasing curb height utilizing appropriate fasteners, gusset plates, and framing anchors.
- R. Use only sound, thoroughly seasoned wood materials of longest practical lengths and sizes to minimize jointing. Use materials free from warp which cannot be easily corrected by anchoring and attachment. Sort out and discard warped material and material with other defects which would impair quality of work.

7.2 CLEAN UP

- A. Premises shall be kept in a neat and orderly condition.
- B. After installation of all rough carpentry, contractor shall remove all construction debris and equipment from job site.

END OF SECTION

SECTION 06 41 00 - ARCHITECTURAL WOOD CASEWORK

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Specially fabricated cabinet units.
- B. Relocated existing cabinets
- C. New plastic laminate countertops to be installed on existing cabinets.
- D. Cabinet hardware.
- E. Preparation for installing utilities.

1.2 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Support framing, grounds, and concealed blocking.
- B. Section 12 36 00 - Countertops.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene a preinstallation meeting not less than one week before starting work of this section; require attendance by all affected installers.

1.4 SUBMITTALS

- A. Shop Drawings: Indicate size, material, veneer, and AWI grade, component profiles and elevations, assembly methods, joint details, fastening methods, accessory listings, hardware location and schedule of finishes.
- B. Product Data: Provide data for hardware accessories.
- C. Product Data: For composite wood products, documentation indicating that product contains no urea formaldehyde.
- D. Samples: Manufacturer's full range of colors, patterns, and textures for plastic laminate and polyurethane mouldings for Architect's selection.
- E. Product Data: For adhesives, documentation including printed statement of VOC content.
- F. Close-out Submittals:
 - 1. Updated As-Built drawings/spec. and shop drawings
 - 2. Manufacturer contact names and addresses
 - 3. Product laminate/stain color numbers, etc.
 - 4. Additional key masters and locksets for attic stock of each type used.

1.5 QUALITY ASSURANCE

- A. Perform work in accordance with AWI/AWMAC Architectural Woodwork Quality Standards Illustrated, Custom quality, unless other quality is indicated for specific items.
- B. Fabricate millwork and cabinetry in accordance with ANSI A161.1, NEMA LD3, and general static load testing performed and certified by an independent testing agency.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years of documented experience.
- D. Manufacturer Qualifications: Member in good standing of the Architectural Woodwork Institute (AWI) and familiar with the AWI/AWMAC QSI.
- E. Quality Certification: Provide inspection and quality certification of completed custom cabinets in accordance with AWI/AWMAC Quality Certification Program.
- F. Delivery Conference: 48 hours prior to delivery, notify Architect of delivery date and time. At the Architect's discretion, a representative of the Architect may be present at the time of delivery to review and observe casework prior to installation. Casework not conforming to the specified requirements, as reasonably determined by the Architect's representative, shall be removed and returned to manufacturer for repair or replacement at no additional cost to the Owner or increase in time.

1.6 SAMPLE MOCK-UP

- A. Provide mock-up of typical base cabinet, wall cabinet, and countertop, including hardware, finishes, and plumbing accessories.
- B. Locate where directed.
- C. Approved mock-up may remain as part of the Work.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect units from moisture damage.

1.8 FIELD CONDITIONS

- A. During and after installation of custom cabinets, maintain temperature and humidity conditions in building spaces at same levels planned for occupancy.
- B. Environmental Requirements: do not install casework until permanent HVAC systems are operating and temperature and humidity have been stabilized for at least one (1) week.
 - 1. Manufacturer/Supplier shall advise Contractor of temperature and humidity requirements for architectural casework installation areas.
- C. Conditions: Do not store or install casework in building until concrete, masonry, and drywall/plaster work is dry.

1.9 WARRANTY

- A. Warranty 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. 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. Casework Manufacturers must have a minimum of five (5) years experience manufacturing products.
- B. Acceptable manufacturers are limited to the following:
- C. ACN Construction Co.
 - 1. Ameritek Design, Inc.
 - 2. Calmar Manufacturing Co., Inc. (Tru-Bilt System One)
 - 3. Casework Services, Inc. (CSI)
 - 4. Fixture Concepts
 - 5. Giles & Giles, Inc., (Institutional Modular Casework (IMC)
 - 6. Global Woodworks
 - 7. Imperial Mill & Fixture, Inc.
 - 8. Jericho Woodworks
 - 9. K & J Woodworks
 - 10. K P Cabinets
 - 11. LabSource (Case Systems, Inc.)
 - 12. LSI Corporation
 - 13. Layne Corporation, Architectural Millwork, Inc.
 - 14. Macintosh,
 - 15. Panel Tech, Inc.
 - 16. Roomi International Industries, Inc.
 - 17. School Specialty
 - 18. South Texas Woodmill, Inc.
 - 19. Terrill Manufacturing Co., Trenstyle Casework
 - 20. TMI Systems Design Corp.

2.2 WOOD-BASED COMPONENTS

- A. Wood fabricated from old growth timber is not permitted.

2.3 LUMBER MATERIALS

- A. Softwood Lumber: NIST PS 20; Graded in accordance with AWI/AWMAC Architectural Woodwork Quality Standards Illustrated, Grade II/Custom; average moisture content of 5-10 percent; species as recommended by manufacturer.
- B. Hardwood Lumber: NHLA; Graded in accordance with AWI/AWMAC Architectural Woodwork Quality Standards Illustrated, Grade II/Custom; average moisture content of 5-10 percent; species as recommended by manufacturer. Except do not use Oak, Elm or similar species which have coarse grain.
- C. Natural Finish Hardwood: Species: AWI "Premium" Grade, White Oak

2.4 PANEL MATERIALS

- A. Use wood veneer core or lumber core at all locations. Provide 3/4 inch thick plywood at all countertops unless noted otherwise
- B. Marine Grade Plywood: 3/4" water resistant treated plywood shall have 24 hour thickness swell factor of five percent or less and 24 hour water absorption factor of ten percent or less; P.S. 51, Type II or better. Provide 3/4" water resistant treated plywood at all lavatory or sink countertops

2.5 LAMINATE MATERIALS

- A. Manufacturers:
 - 1. Formica Corporation: www.formica.com
 - 2. Nevamar: www.nevamar.com
 - 3. Pionite: www.pionite.com
 - 4. Wilsonart International, Inc: www.wilsonart.com
 - 5. Arborlite: www.arborlite.com
 - 6. Substitutions: See Section 01 25 00 - Substitution Procedures.
- B. High Pressure Decorative Laminate (HPDL): NEMA LD 3, types as recommended for specific applications and as follows:
 - 1. Countertops: HGS, 0.048 inch nominal thickness, through color, colors as scheduled, finish as scheduled.
 - 2. Horizontal and Exterior Vertical Surfaces: HGL, 0.039 inch nominal thickness, through color, colors as scheduled, finish as scheduled.
 - 3. Cabinet Interior Vertical Surfaces: VGS, 0.028 inch nominal thickness, through color, colors as scheduled, finish as scheduled.
 - 4. Laminate Backer: BKL, 0.020 inch nominal thickness, undecorated; for application to concealed backside of panels faced with high pressure decorative laminate.

2.6 EDGING

- A. Provide the following in accordance with "Edging Locations":
 - 1. Flat Edge PVC: "T" mold 0.020 inch. Solid, high-impact, purified, color-thru, acid resistant, machine-applied with hot melt adhesives.
 - 2. 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 radius. Provide eased/radiused edge.

- B. Edging Locations:
 - 1. Cabinet body edge, including door/drawer front spacer rail: Flat Edge PVC, color matched to door/drawer face or as selected.
 - a. Forward edge of interior body components, interior dividers, shelf, and top edges of drawer body: Flat Edge PVC to match cabinet interior surface color.
 - b. Door/Drawer-Front edging, countertops: 3mm PVC, color matched to standard laminates.
- C. At exposed countertop end corners provide radius of one inch or more. Provide 4 inch backsplashes with sealant at top.

2.7 ACCESSORIES

- A. Adhesives - General: Compatible with materials being adhered as instructed by manufacturer for application. Do not use adhesives that contain urea formaldehyde.
 - 1. Type recommended by AWI/AWMAC to suit application.
- B. Fasteners: Size and type to suit application.
- C. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application; galvanized or chrome-plated finish in concealed locations and stainless steel, or chrome-plated finish in exposed locations.
- D. Concealed Joint Fasteners: Threaded steel.

2.8 HARDWARE

- A. Acceptable Manufacturers:
 - 1. National Manufacturing Company; www.natman.com
 - 2. Knape & Vogt Manufacturing Company: www.knapeandvogt.com.
 - 3. Ives; www.iveshinges.com
 - 4. Stanley; www.stanleyhardware.com
- B. Adjustable Shelf Supports:
 - 1. Dual-pin design with anti-tip-up shelf restraints for both 3/4 inch and 1 inch shelves.
 - 2. Include keel to retard shelf slide-off, and slot for mechanical attachment of shelf to clip.
- C. Drawer and Door Pulls: Heavy duty chrome wire pulls – 4 1/2" long
- D. Sliding Door Pulls: Square pulls; Drawer and door pulls shall be chrome wire pull type, and hinges shall be heavy duty type for overlay doors, Stanley No. HT1591, US26D finish.
- E. Locks shall be National five-pin tumbler grooved key type, nickel plated cylinder and cam with two (2) keys and master keyed where doors are scheduled to receive locks, furnish catch Stanley No. 36 on door not receiving lock. All locks on cabinets in the same room are to be keyed alike.
- F. Cabinet locks shall be National Model no C8055 disc tumbler cam lock. Cylinder face and keys to be engraved with matching numbers. Cabinet Locks in each room are to be keyed alike. Locks are to be master keyed to E41A. Provide two (2) keys per room.

- G. Clinic Locks - CCL cam lock Model No B15760-US26D keyed to AUE39. Stamp AUE39 on cam lock face. Provide two (2) keys per room.
 - H. All hardware shall be subject to approval by the Owner/Architect. All keying shall match existing master key system and be approved by the Owner.
 - I. Catches: Magnetic.
 - J. Drawer Slides:
 - 1. Type: Full extension with overtravel.
 - 2. Static Load Capacity: Drawer slides shall be heavy duty, self-closing with positive in-stop and out-stop. Dynamic load rating of 100 lb. life cycle test/150 lb. static load rating. File drawers and paper storage drawers to receive full extension, 100 lb. dynamic rating drawer slides.
 - 3. Mounting: Side mounted.
 - 4. Stops: Integral type.
 - 5. Features: Provide self closing/stay closed and special finish epoxy finish type.
 - K. File Drawer and Paper Storage Slides:
 - 1. Type: Full extension.
 - 2. Static Load Capacity: Drawer slides shall be heavy duty, self-closing with positive in-stop and out-stop. Dynamic load rating of 100 lb. life cycle test/150 lb. static load rating. File drawers and paper storage drawers to receive full extension, 100 lb. dynamic rating drawer slides.
 - 3. Mounting: Side mounted.
 - 4. Stops: Integral type.
 - 5. Features: Provide self closing/stay closed and special finish epoxy coated type.
 - L. Hinges: Heavy-duty, five-knuckle, institutional, self-closing type, BHMA No. A156.9 Grade 1, mill ground, hospital tip, Teflon coated.
 - M. Sliding Door Track Assemblies: Upper and lower track of satin anodized aluminum, with matching shoe equipped with nylon rollers.
 - N. Trash Grommet: 6 inch dia. by 2 inch deep; Doug Mockett & Co.
 - O. Table Legs: No. TL34P-3 manufactured by Doug Mockett & Co. Satin Chrome finish
 - P. Hardware Finish: Satin Stainless Steel, U.O.N.
 - Q. At teachers wardrobe/cabinets, ensure hanging rod is mechanically fastened and not removable.
- 2.9 SHOP TREATMENT OF WOOD MATERIALS
- A. Provide UL approved identification on fire retardant treated material.
 - B. Deliver fire retardant treated materials cut to required sizes. Minimize field cutting.
- 2.10 SPECIALTY ITEMS
- A. Grommets:

1. Size: 3 inches diameter with "Flip-Top"™ tab in cap.
2. Colors: As selected by Architect from manufacturer's available colors.
3. Number/Location: Where electrical, telephone, and computer data wiring need to pass through tops whether shown or not.
4. Approved Manufacturer: Doug Mockett & Company, Inc., Manhattan Beach, CA; (800) 523-1269, or Architect approved equal.

B. Keyboard Drawers (where indicated on drawings):

1. MicroComputer Accessories Model No. MCA-6110, molded plastic tray with wrist rests which lifts up to reveal a pencil storage compartment.
 - a. Sliding drawers to extend 9-3/4 inches past edge of desk.
 - b. 21-1/2 inches x 2 inches x 14-1/2 inches outside dimensions and 20 inches x 3 inches x 8-3/4 inches inside.
 - c. Lock-in, lock-out feature.
 - d. Factory attached slotted surface mounting brackets.
 - e. Precision ball bearings and nylon retainers for quiet operation.
2. Steel Rod Painted: Standard steel pipe with steel shoes

C. Molded Plastic Totes: High-impact 100 Plastic totes and bins to match CFISD size and shape. Provide nameplates for each plastic tote. Final number and location as shown on the drawings.

2.11 FABRICATION

- A. Cabinet Style: Flush overlay.
- B. Cabinet Doors and Drawer Fronts: Flush style.
- C. Drawer Construction Technique: Dovetail joints.
- D. Assembly: Shop assemble cabinets for delivery to site in units easily handled and to permit passage through building openings.
- E. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.
- F. Fitting: When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide matching trim for scribing and site cutting.
- G. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel arises. Locate counter butt joints minimum 2 feet from sink cut-outs.
 1. Apply laminate backing sheet to reverse side of plastic laminate finished surfaces.
 2. Cap exposed plastic laminate finish edges with material of same finish and pattern.
- H. Provide cutouts for plumbing fixtures. Verify locations of cutouts from on-site dimensions. Prime paint cut edges.
- I. Cabinet components shall be of the following minimum core thicknesses:
 1. Cabinet backs, drawer body, and drawer bottoms: 1/2 inch plywood
 2. 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 plywood

3. Provide 3/4 inch thick plywood at all countertops unless noted otherwise, except use marine grade plywood core at counters with sinks.
 4. Shelves: 3/4 inch plywood (veneer or lumber) core for 30 inches long or less, 1 inch thick plywood (veneer or lumber) core for more than 30 inches long; 14 inches deep, unless otherwise noted. Provide vertical dividers for shelves over 36 inches long.
 5. Cabinet Toe-Base: Provide Komatsu 1" thick by 4" high plastic base at all cabinet bases.
- J. Countertops and Backsplashes:
1. Countertops: Provide countertops with 3 mm PVC edge at work surfaces and no-drip edge at tops with sinks in continuous lengths. Provide field glued splines at joints. No joints closer than 24 inches either side of sink cutout.
 2. Backsplash: Integral to countertop, 4 inch high unless otherwise shown. Fabricate with single continuous sheet of laminate from front counter to top of splash with no joints from horizontal to vertical application. No joints shall occur at sink openings. Provide sealant on top of all backsplashes.
 3. At exposed countertop end corners, provide 1-1/2 inch radius.
 4. Use marine grade plywood at countertops with sinks.
 5. Refer to Section 12 36 00 for other countertops as shown or scheduled.
- K. ADA, Americans with Disabilities Act Requirements: The following special requirements shall be met, where specifically indicated on architectural plans as "ADA", or by General Note. Shall be in compliance with Federal Register Volume 56, No. 144, Rules and Regulations:
1. Countertop height: Refer to construction drawing elevations for all countertop heights.
 2. Kneespace clearance: minimum 29 inches A.F.F. at apron, and 30 inches clear span width.
 3. 12 inch deep shelving, adjustable or fixed: Not to exceed a range from 9 inches A.F.F. to 54 inches A.F.F.
 4. Wardrobe cabinets: Provide with rod/shelf adjustable to 48 inches A.F.F. at a maximum 21 inch shelf depth.
 5. Sink cabinet clearances: In addition to above, upper kneespace frontal depth shall be no less than 8 inches, and lower toe frontal depth shall be no less than 11 inches, at a point 9 inches A.F.F., and as further described in Volume 56, Section 4.19.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify adequacy of backing and support framing.
- B. Verify location and sizes of utility rough-in associated with work of this section.

3.2 INSTALLATION

- A. Set and secure custom cabinets in place, assuring that they are rigid, plumb, and level.
- B. Use fixture attachments in concealed locations for wall mounted components.
- C. Use concealed joint fasteners to align and secure adjoining cabinet units.
- D. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim for this purpose.

- E. Secure cabinets to floor using appropriate angles and anchorages.
- F. Remove and relocate both base and upper cabinets as necessary to match the new locations. Set and secure cabinets in place, assuring that they are rigid, plumb, and level and ready for scheduled countertop installation.

3.3 ADJUSTING

- A. Adjust moving or operating parts to function smoothly and correctly.

3.4 CLEANING

- A. Clean casework, counters, shelves, hardware, fittings, and fixtures.

END OF SECTION

SECTION 07 01 50.19 - PREPARATION FOR REROOFING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Preparation of existing roof for re-cover with new modified bitumen roof membrane.
 - 2. Removal of flashings and counterflashings.
- B. Related Requirements:
 - 1. Section 06 10 00 "Rough Carpentry" for wood curbs, nailers, and sheathing.
 - 2. Section 07 52 00 "Modified Bitumen Membrane Roofing" for installation of new roofing.

1.2 DEFINITIONS

- A. Roof Re-Cover Preparation: Existing roofing system is to remain and be prepared for new roof installed over it.
- B. Roofing Terminology: Definitions in ASTM D 1079 and glossary of NRCA's "The NRCA Roofing Manual: Membrane Roof Systems" apply to work of this Section.

1.3 PREINSTALLATION MEETINGS

- A. Preliminary Roofing Conference: Before starting removal Work, conduct conference at Project site.
 - 1. Meet with Owner, Architect, roofing Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
 - 2. Review methods and procedures related to re-roofing, including, but not limited to, the following:
 - a. Reroofing preparation, including roofing system manufacturer's written instructions.
 - b. Temporary protection requirements for existing roofing system components that are to remain.
 - c. Existing roof drains and roof drainage during each stage of reroofing, and roof-drain plugging and plug removal.
 - d. Construction schedule and availability of materials, Installer's personnel, equipment, and facilities needed to avoid delays.
 - e. Existing roof deck conditions requiring Architect notification.
 - f. Existing roof deck removal procedures and Owner notifications.
 - g. Structural loading limitations of roof deck during reroofing.
 - h. Base flashings, special roofing details, drainage, penetrations, equipment curbs, and condition of other construction that affect reroofing.
 - i. HVAC shutdown and sealing of air intakes.
 - j. Governing regulations and requirements for insurance and certificates if applicable.
 - k. Existing conditions that may require Architect notification before proceeding.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.5 FIELD CONDITIONS

- A. Existing Roofing System: Two-ply Siplast Paradiene 2030 CBH modified bitumen roof membrane system (Siplast Guarantee No. 19742) over lightweight insulating concrete roof deck.
- B. Protect building to be reroofed, adjacent buildings, walkways, site improvements, exterior plantings, and landscaping from damage or soiling from reroofing operations.
- C. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities.
- D. Conditions existing at time of inspection for bidding will be maintained by Owner as far as practical.
- E. Weather Limitations: Proceed with reroofing preparation only when existing and forecasted weather conditions permit Work to proceed without water entering new or existing roofing system or building.
 - 1. Remove only as much flashing in one day as can be made watertight in the same day.
- F. Hazardous Materials: It is not expected that hazardous materials, such as asbestos-containing materials, will be encountered in the Work.
 - 1. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner.
 - a. Hazardous materials will be removed by Owner under a separate contract.

PART 2 - PRODUCTS

2.1 TEMPORARY ROOFING AND PROTECTION MATERIALS

- A. Design and selection of materials for temporary roofing and protection, if needed, are Contractor's responsibilities.

2.2 INFILL AND REPLACEMENT MATERIALS

- A. Wood blocking, curbs, and nailers are specified in Section 06 10 00 "Rough Carpentry."
- B. Modified Bitumen Base, Stripping, and Flashing Reinforcing Ply:
 - 1. Siplast Paradiene 20
- C. Fasteners: Factory-coated steel fasteners with metal plates listed in FM Approvals' RoofNav, and acceptable to new roofing system manufacturer.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Shut off rooftop utilities and service piping before beginning the Work.
- B. Test existing roof drains to verify that they are not blocked or restricted.

1. Immediately notify Architect of any blockages or restrictions.
 - C. Coordinate with Owner to shut down air-intake equipment in the vicinity of the Work.
 1. Cover air-intake louvers before proceeding with reroofing work that could affect indoor air quality or activate smoke detectors in the ductwork.
 - D. Have sufficient and suitable materials on-site to facilitate rapid installation of temporary protection in the event of unexpected rain.
 - E. Maintain roof drains in functioning condition to ensure roof drainage at end of each workday.
 1. Prevent debris from entering or blocking roof drains and conductors.
 - a. Use roof-drain plugs specifically designed for this purpose.
 - b. Remove roof-drain plugs at end of each workday, when no work is taking place, or when rain is forecast.
 2. If roof drains are temporarily blocked or unserviceable due to roofing system removal or partial installation of new roofing system, provide alternative drainage method to remove water and eliminate ponding.
 - a. Do not permit water to enter into or under existing roofing system components that are to remain.
 - F. Remove indicated mechanical equipment and curbs.
 - G. Fill in abandoned openings or penetrations in deck to match existing deck construction.
 - H. If roof surface appears unsuitable for receiving new roofing or if structural integrity is suspect, immediately notify Architect.
 1. Do not proceed with installation until directed by Architect.
 - I. Clean all substrates of contaminants, such as asphalt, sheet materials, dirt, and debris.
- 3.2 ROOF TEAR-OFF
- A. Lower removed roofing materials to ground and onto lower roof levels, using dust-tight chutes or other acceptable means of removing materials from roof areas.
 - B. Walkpads: Remove walk pads on the existing roof surface. Replace areas damaged during removal with additional layers of the stripping ply, applied in the specified adhesive, bringing the areas back to level with surrounding surfaces prior to application of the finish ply. Upon completion of the finish ply, install the new walk pads to replace the existing, at all access points and around all serviceable equipment.
 - C. Preparation of the Existing Finish Ply: Sweep loose granules and remove blisters, buckles and surface irregularities. Patch all such areas, bringing them back level with surrounding surfaces using layers of the stripping ply materials.
 - D. Wet Areas: Remove any areas of the existing assembly where moisture is present and replace with compatible materials, bringing the areas back to level with surrounding surfaces. Apply a layer of the specified stripping ply over all repaired areas prior to application of the finish ply.

- E. Metal Edge: Remove and dispose of edge metal and flanged metal flashings. Apply the specified stripping ply at the roof edge, lapping a minimum of 18 inches over the prepared surface of the existing roof system. Turn the stripping ply past the roof edge and over the nailer.
- F. Flanged Metal Flashings: Cut the flanged metal flashings at roof level and remove/dispose of the materials that are not sandwiched between roofing plies.
- G. Roof Drains: Remove the lead and existing flashing plies 4 feet in each direction from the drains. Remove the strainers and clamping rings from the drain assemblies.
- H. Preparation of the Existing Aluminum Flashing Sheets: Apply a torch to the foil-faced surfaces of the existing flashing sheets and remove the foil surfacing. Score the foil surfaces at the laps of the sheets to facilitate removal. Care must be taken while scoring the foil surfacing to prevent cutting the underlying reinforcement.

3.3 DISPOSAL

- A. Collect demolished materials and place in containers.
 - 1. Promptly dispose of demolished materials.
 - 2. Do not allow demolished materials to accumulate on-site.
 - 3. Storage or sale of demolished items or materials on-site is not permitted.
- B. Transport and legally dispose of demolished materials off Owner's property.

END OF SECTION

SECTION 07 21 00 - THERMAL INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Batt insulation in exterior and interior wall construction.
- B. Rigid board on masonry walls.

1.2 RELATED REQUIREMENTS

- A. Section 07 84 00 - Firestopping: Fire safing insulation.
- B. Section 09 81 00 - Acoustical Insulation.

1.3 SUBMITTALS

- A. Product Data: Provide data on product characteristics, performance criteria, and product limitations.
- B. Manufacturer's Installation Instructions: Include information on special environmental conditions required for installation and installation techniques.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements, and that products contain no asbestos.

1.4 FIELD CONDITIONS

- A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

1.5 SEQUENCING

- A. Sequence work to ensure fireproofing and firestop materials are in place before beginning work of this section.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
 - 2. Substitutions: See Section 01 25 00 - Substitution Procedures.

2.2 APPLICATIONS

- A. Insulation Inside Masonry Cavity Walls: Extruded polystyrene board.
- B. Insulation in Metal Framed Walls: Batt insulation with no vapor retarder.

2.3 FOAM BOARD INSULATION MATERIALS

- A. Extruded Polystyrene Board Insulation: ASTM C 578, Type IV; Extruded polystyrene board with either natural skin or cut cell surfaces; with the following characteristics:
 - 1. Flame Spread Index: 75 or less, when tested in accordance with ASTM E84.
 - 2. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.
 - 3. Board Thickness: Two inches.
 - 4. Board Edges: Square.
 - 5. Compressive Resistance: 25 psi.
 - 6. Thermal Resistance: $R = 5$ per inch minimum
 - 7. Water Absorption, maximum: 0.1 percent, volume.
 - 8. Manufacturers:
 - a. Dow Chemical Co: www.dow.com.
 - b. Owens Corning Corp: www.owenscorning.com.
 - c. Pactiv Building Products: greenguard.pactiv.com.

2.4 BATT INSULATION MATERIALS

- A. Batt Insulation: ASTM C 665; preformed batt; friction fit, conforming to the following:
 - 1. Material: Glass or mineral fiber.
 - 2. Material: Rock or slag fiber, not glass fiber.
 - 3. Flame Spread Index: 25 or less, when tested in accordance with ASTM E 84.
 - 4. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E 84.
 - 5. Combustibility: Non-combustible, when tested in accordance with ASTM E 136.
 - 6. Thickness/Thermal Resistance:
 - a. 3.5 inch/R-13
 - b. 6 inch/R-19
 - c. 8 inch/R-25
 - 7. Facing: Unfaced.
 - 8. Manufacturers:
 - a. CertainTeed Corporation: www.certainteed.com.
 - b. Johns Manville Corporation: www.jm.com.
 - c. Knauf Insulation GmbH: www.knaufinsulation.us.
 - d. Owens Corning Corp: www.owenscorning.com.
 - e. Thermafiber, Inc: www.thermafiber.com.

2.5 ACCESSORIES

- A. Wire Mesh: Galvanized steel, hexagonal wire mesh.
- B. No. 22 gauge galvanized spandrel perimeter angles
- C. Adhesives - General: Compatible with materials being adhered as instructed by insulation manufacturer for application; maximum VOC content of 50 g/L; GreenSeal GS-36; in lieu of labeled product, independent test report showing compliance is acceptable.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation and adhesive.
- B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

3.2 BOARD INSTALLATION AT EXTERIOR WALLS - DIRECT ADHERED APPLIED

- A. Apply adhesive to back of boards:
 - 1. Three continuous beads per board length.
- B. Install boards horizontally on walls.
 - 1. Place boards to maximize adhesive contact.
 - 2. Install in running bond pattern.
 - 3. Butt edges and ends tightly to adjacent boards and to protrusions.
- C. Extend boards over expansion joints, unbonded to wall on one side of joint.
- D. Tape insulation board joints.

3.3 BATT INSTALLATION

- A. Install insulation in accordance with manufacturer's instructions.
- B. Install in exterior wall and furring spaces without gaps or voids. Do not compress insulation.
- C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.
- D. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation. Insulation shall be tight within spaces in partitions, around cut openings, behind and around electrical and mechanical items within or behind partitions and tight to items passing through partitions.
- E. Provide wire mesh at locations where the insulation is unsupported vertically by interior or exterior finishes.
- F. Wall areas above ceiling: At side wall insulation in ceiling cavity, install adhesive-mounted impaling devices with metal caps at 2 feet-0 inches vertically and at four (4) inches from each side of blankets horizontally. Install blankets with four (4) foot dimension running vertically on spikes, keeping blankets tight to exterior wall without crushing into each other.
- G. Tape seal butt ends, lapped flanges, and tears or cuts in membrane.

3.4 PROTECTION

- A. Do not permit installed insulation to be damaged prior to its concealment.

END OF SECTION

SECTION 07 25 00 - WEATHER BARRIERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fluid-applied, vapor permeable membrane air barrier.
2. Self-adhering

B. Related Requirements:

1. Section 04 21 00 "Architectural Unit Masonry" for masonry tie-in to adjacent construction systems.
2. Section 07 21 00 "Thermal Insulation" for installation of cavity wall insulation over air barrier membrane.
3. Section 07 52 00 "Modified Bitumen Membrane Roofing" for air barrier interface with roof membrane.
4. Section 07 65 00 "Flexible Flashing" for counterflashing strips and modified bituminous flashing strips.
5. Section 07 62 00 "Sheet Metal Flashing and Trim" for sheet metal flashings required for complete watertight envelope assembly.
6. Section 07 92 00 "Joint Sealants" for joint-sealant materials and installation.

1.2 DEFINITIONS

- ##### A. Air Barrier:
- Air tight barrier made of material that is relatively air impermeable but water vapor permeable, both to the degree specified, with sealed seams and with sealed joints to adjacent surfaces.
Note: For the purposes of this specification, vapor impermeable air barriers are classified as vapor retarders.

1.3 SUBMITTALS

A. Product Data:

For each type of product.

1. Include manufacturer's written instructions for evaluating, preparing, and treating substrate; technical data; and tested physical and performance properties of products.
2. Identify all materials and accessories required for complete air- and water-tight installation to be approved by air barrier manufacturer as complete system and warranted as such.

B. Shop Drawings:

For air barrier assemblies.

1. Show locations and extent of air barrier. Include details for substrate joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
2. Include details of interfaces with other materials that adjoin the air barrier.

C. Manufacturer's Installation Instructions:

Indicate preparation, installation methods, and storage and handling criteria.

1.4 MOCK-UP

- A. Install weather barrier materials in mock-up specified in Section 01 40 00.

1.5 FIELD CONDITIONS

- A. Maintain temperature and humidity recommended by the materials manufacturers before, during and after installation.

PART 2 - PRODUCTS

2.1 WEATHER BARRIER ASSEMBLIES

- A. Air Barrier:
1. On outside surface of masonry behind face brick in exterior walls use cold fluid applied air barrier coating.

2.2 AIR BARRIER MATERIALS (WATER VAPOR PERMEABLE AND WATER-RESISTIVE)

- A. Air Barrier Coating: Cold-fluid-applied, vapor permeable, elastomeric waterproofing membrane.
1. Material: Water-based acrylic or polymer-modified bitumen, with VOC content of zero.
 2. Acceptable Substrates: Stated by manufacturer as suitable for installation on visibly damp surfaces and concrete that has hardened but is not fully cured ("green" concrete) without requiring a primer.
 3. Adhesion to Paper and Glass Mat Faced Sheathing: Sufficient to ensure failure due to delamination of sheathing.
 4. Dry Film Thickness: 25 mils (0.025 inch), minimum.
 5. Air Permeance: 0.004 cubic feet per square foot, maximum, when tested in accordance with ASTM E2178.
 6. Water Vapor Permeance: 10 perms minimum, 25 perms maximum, when tested in accordance with ASTM E96/E 96M.
 7. Ultraviolet and Weathering Resistance: Approved in writing by manufacturer for minimum of 6 months weather exposure.
 8. Elongation: 300 percent, minimum, when tested in accordance with ASTM D412.
 9. Products:
 - a. W.R. Meadows, Inc.; Air-Shield LMP: www.wrmeadows.com.
 - b. Grace Construction Products; Perm-A-Barrier VP: www.na.graceconstruction.com.
 - c. Henry Company; Air-Bloc 31MR: www.henry.com.
 - d. Dupont Tyvek Fluid Applied WB System: www.weatherization.tyvek.com.
 - e. Substitutions: See Section 01 25 00 - Substitution Procedures.

2.3 SEALANTS

- A. Sealant: as specified in Section 07 90 05.
- B. Sealant Backers: As specified in Section 07 90 05.
- C. Primers, Cleaners, and Other Sealant Materials: As recommended by sealant manufacturer, appropriate to application, and compatible with adjacent materials.

2.4 ADHESIVES

- A. Mastic Adhesive : Compatible with sheet seal and substrate, thick mastic of uniform knife grade consistency .
- B. Non-Curing Adhesive : Compatible with sheet seal and substrate, permanently non-curing.

2.5 ACCESSORY MATERIALS

- A. General: Accessory materials recommended by air-barrier manufacturer to produce a complete air-barrier assembly and compatible with primary air-barrier material.
- B. Primer: Liquid waterborne primer recommended for substrate by air-barrier material manufacturer.
- C. Counterflashing Strip: Through-wall membrane flashing specified in Section 07 65 00 "Flexible Flashing."
- D. Modified Bituminous Transition Strip: Self-adhering door and window flashing specified in Section 07 65 00 "Flexible Flashing."
- E. Butyl Strip: Vapor retarding, 30 to 40 mils thick, self-adhering; polyethylene-film-reinforced top surface laminated to layer of butyl adhesive with release liner backing.
- F. Flexible Silicone Transition: Extruded, ribbed silicone sheet for sealing transitions between curtain wall framing and wall openings where indicated.
 - 1. Basis-of-Design: Proglaze ETA Connections as manufactured by Tremco, or comparable products by alternate manufacturer.
 - 2. Size: As required.
- G. Substrate-Patching Membrane: Manufacturer's standard trowel-grade substrate filler.
- H. Adhesive and Tape: Air-barrier manufacturer's standard adhesive and pressure-sensitive adhesive tape.
- I. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304, 0.0250 inch thick, and Series 300 stainless-steel fasteners.
- J. Joint Sealant: ASTM C 920, single-component, neutral-curing silicone; Class 100/50 (low modulus), Grade NS, Use NT related to exposure, and, as applicable to joint substrates indicated, Use O. Comply with Section 07 92 00 "Joint Sealants."
- K. Termination Mastic: Air-barrier manufacturer's standard cold fluid-applied elastomeric liquid; trowel grade.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces and conditions are ready to accept the work of this section.

3.2 PREPARATION

- A. Clean, prepare, treat, and seal substrate according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for air-barrier application.
- B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.
- C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
- D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching membrane.
- E. Remove excess mortar from masonry ties, shelf angles, and other obstructions.
- F. At changes in substrate plane, apply modified bituminous transition strip, lapping strip a minimum of 3 inches onto each surface.
- G. Cover gaps in substrate plane with a modified bituminous transition strip covered with a stainless steel flashing strip set in a continuous bed of sealant. Secure stainless steel flashing with gasketed fasteners, and lap additional transition strips a minimum of 3 inches over each edge of sheet metal flashing.

3.3 JOINT TREATMENT

- A. Concrete and Masonry: Prepare, treat, rout, and fill joints and cracks in substrate according to ASTM C 1193 and air-barrier manufacturer's written instructions. Remove dust and dirt from joints and cracks complying with ASTM D 4258 before coating surfaces.
 - 1. Prime substrate and apply a single thickness of air-barrier manufacturer's recommended preparation coat extending a minimum of 3 inches along each side of joints and cracks. Apply a double thickness of fluid air-barrier material and embed a joint reinforcing strip in preparation coat.

3.4 INSTALLATION

- A. Install materials in accordance with manufacturer's instructions.
- B. Air Barriers: Install continuous air tight barrier over surfaces indicated, with sealed seams and with sealed joints to adjacent surfaces. Install to wet mil thickness as instructed by manufacturer.
- C. Apply sealants and adhesives within recommended application temperature ranges. Consult manufacturer if temperature is out of this range.
- D. Self-Adhesive Sheets:
 - 1. Prepare substrate in manner recommended by sheet manufacturer; fill and tape joints in substrate and between dissimilar materials.
 - 2. Lap sheets shingle-fashion to shed water and seal laps air tight.
 - 3. Once sheets are in place, press firmly into substrate with resilient hand roller; ensure that all laps are firmly adhered with no gaps or fishmouths.
 - 4. Use same material, or other material approved by sheet manufacturer for the purpose, to seal to adjacent construction and as flashing.

5. At wide joints, provide extra flexible membrane allowing joint movement.

E. Coatings:

1. Prepare substrate in manner recommended by coating manufacturer; treat joints in substrate and between dissimilar materials as recommended by manufacturer.
2. Use flashing to seal to adjacent construction and to bridge joints.

F. Openings and Penetrations in Exterior Weather Barriers:

1. Install flashing over sills, covering entire sill frame member, extending at least 5 inches onto weather barrier and at least 6 inches up jambs; mechanically fasten stretched edges.
2. At openings to be filled with frames having nailing flanges, seal head and jamb flanges using a continuous bead of sealant compressed by flange and cover flanges with at least 4 inches wide; do not seal sill flange.
3. At openings to be filled with non-flanged frames, seal weather barrier to all sides of opening framing, using flashing at least 9 inches wide, covering entire depth of framing.
4. At head of openings, install flashing under weather barrier extending at least 2 inches beyond face of jambs; seal weather barrier to flashing.
5. At interior face of openings, seal gap between window/door frame and rough framing, using joint sealant over backer rod.
6. Service and Other Penetrations: Form flashing around penetrating item and seal to weather barrier surface.
7. Patch and cover all joints and screw heads after installation of screws have been completed with air barrier product to form continuous barrier.

3.5 FIELD QUALITY CONTROL

- A. Field inspections and tests will be performed by an independent testing agency under provisions of Section 01 40 00.
- B. Do not cover installed weather barriers until required inspections have been completed.
- C. Obtain approval of installation procedures by the weather barrier manufacturer based on a mock-up installed in place, prior to proceeding with remainder of installation.
- D. Take thickness measurements at every 100 square feet of wet product applied to substrate.
- E. Take digital photographs of each portion of the installation prior to covering up.
- F. Twenty (20) days after completion of this portion of the work, at the discretion of the Architect, demonstrate by running water test that the Work of this Section will successfully repel water.
 1. Notify the Architect at least 72 hours in advance, and conduct the test in the Architect's presence.
 2. By means of an outrigger, or similar acceptable equipment, place the nozzle of a 3/4 inch garden hose at a point approximately 10 feet-0 inches away from top of wall where approved by the Architect, aiming the nozzle at slight downward angle to direct full stream of water onto wall.
 3. Run water onto wall at full available force for not less than four (4) hours.
 4. Upon completion of the four (4) hour period, inspect interior surfaces of wall for evidence of moisture penetration.

- G. If evidence of moisture penetration is discovered, apply an additional coat of approved weather barrier to exterior surface in areas directed by the Architect, repeating application and testing (at no additional cost to the Owner) until no evidence of moisture penetration is found.

3.6 PROTECTION

- A. Do not leave materials exposed to weather longer than recommended by manufacturer.

END OF SECTION

SECTION 07 52 00 MODIFIED BITUMINOUS MEMBRANE ROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Recovering of existing modified bitumen roof system on lightweight insulating concrete deck.
2. New modified bitumen roof system on lightweight insulating concrete deck.
3. It is the intent of this Section that the work shall:
 - a. Provide a watertight facility;
 - b. Conform to applicable building code requirements, performance and regulatory requirements, and requirements of authorities having jurisdiction;
 - c. Include roof-related sheet metal flashings specified in Section 07 62 00 "Sheet Metal Flashing and Trim;" and
 - d. Be performed to obtain a single responsibility total system warranty.

B. Related Sections:

1. Section 06 10 00 "Rough Carpentry" for wood nailers, curbs and cant strips
2. Section 07 01 50.19 "Preparation for Reroofing" for tear-off of metal flashings and preparation of existing roof surfaces for recovering.
3. Section 07 25 00 "Weather Barriers" for air/weather barrier interface with roofing system.
4. Section 07 62 00 "Sheet Metal Flashing and Trim" for flashings, perimeter trim, and roof-related sheet metal.
5. Section 07 72 00 "Roof Accessories" for roof curbs and roof hatches.
6. Division 22 Sections for roof drains.
7. Division 26 Sections for lightning protection systems, devices and connectors.

1.2 DESCRIPTION OF WORK

A. ASSEMBLY #1 - Membrane Overlayment

1. Deck: Existing lightweight insulating concrete on galvanized metal deck. Slope: 1/4 inch.
2. Existing Assembly: Paradiene 2030 IH roof membrane system (Siplast Guarantee No 19742). Heat and remove the foil of the Veral Aluminum base flashings at all of the mechanical curbs, expansion joints, and wall flashing conditions. Remove any wet/damaged/deteriorated membrane plies and repair any blisters with compatible materials, bringing them back to a level with surrounding surfaces and into a watertight condition. Replace all sheet metal components including gravel guard edge details and raised edge details, expansion joints, mechanical curbs, and walls.
3. Internal Drains: Remove the lead and existing flashing plies 4 feet in each direction from the drains.
4. Substrate Preparation: Fastener withdrawal tests must be conducted prior to application to confirm fasteners to be used. Mechanically fasten the Paradiene 20/30 FR roof system through the existing perlite cover panel and polyisocyanurate insulation into the underlying metal deck using approved fasteners with 3-inch plates. Fasten each sheet every 24 inches through the laps and stagger fasten the remainder of the sheet in 1 row with fasteners on 24-inch centers.
5. Roof Membrane:
 - a. Base Ply: Paradiene 20, applied in PA-311 R Adhesive.

- b. Finish Ply: Paradiene 30 FR BW, applied in PA-311 R Adhesive.
- 6. Flashing System: Veral Aluminum, torch applied.

B. ASSEMBLY #2 - New Construction

- 1. Deck: Lightweight insulating concrete specified in Section 03 52 16. Slope: 1/4 inch.
- 2. Base Sheet: Parabase Plus, mechanically attached using Zono-Tite Fasteners. Fasten each sheet every 7 inches through the laps and stagger fasten the remainder of the sheet in 3 rows on nominal 12-inch centers with fasteners in each row on 10-inch centers. Increase the fastening pattern by 70% at the perimeter of the roof and 160% in the corners.
- 3. Roof Membrane:
 - a. Base Ply: Paradiene 20 TG, torch-applied.
 - b. Finish Ply: Paradiene 30 FR TG BW, torch-applied.
- 4. Flashing System: Veral Aluminum, torch applied.

1.3 DEFINITIONS

- A. Roofing Terminology: See ASTM D 1079 and glossary of NRCA's "The NRCA Roofing and Waterproofing Manual" for definition of terms related to roofing work in this Section.

1.4 SUBMITTALS

- A. Product Data: Roofing-system manufacturer's literature, including written instructions for evaluating, preparing, and treating substrate; technical data including tested physical and performance properties; and application instructions.
 - 1. Provide for membrane and base flashing materials, roofing cement, primer, adhesive, liquid flashing, and fasteners.
 - 2. Submit manufacturer's printed instructions, schedules, charts, literature, and illustrations to indicate the performance, fabrication procedures, product variations, fastener pattern layout and penetration depths, and accessories to be used in the Work.
- B. Include temperature ranges for storage and application of materials, and special cold weather application requirements or limitations.
- C. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other work. Include manufacturer's reviewed and approved details that are project specific and include dimensions, scaled layouts, assembly profiles, etc. Manufacturer's generic details will not be accepted.
 - 1. Base flashings and membrane terminations.
 - 2. Roof Layout Plan identifying location and dimensions of all roof field, perimeter, and corner areas.
 - 3. Base sheet fastening patterns for corner, perimeter, and field-of-roof locations.
 - 4. Location and type of each roof penetration.
 - 5. Walkway pad plan and details.
 - 6. Proposed temporary, watertight, tie-off details for each substrate type.
 - a. Interface with sheet metal components (per Section 07 62 00), including but not limited to:
 - Flashings and counterflashings
 - b. Each type of flashing detail, including perimeter and penetration details.
 - c. Stack flashing assemblies
 - d. Edge and fascia sections

- e. Interface with coping cap assemblies (per Section 07 62 00)
 - f. Interface with roofing accessories including but not limited to:
 - g. Equipment curbs
 - h. Roof hatches
 - i. Expansion joints assemblies
 7. Method of installing roofing membrane with RoofNav requirements.
- D. Samples for Verification: For the following products:
- E. Sheet roofing materials, including membrane cap sheet, of color specified.
 1. Walkway pads or rolls.
 2. Six insulation fasteners of each type, length, and finish.
- F. Installer's Certificate
 1. Signed by roofing-system manufacturer, certifying that Roofing Installer complies with manufacturer's requirements to install specified, warranted, roofing system.
 2. Submit evidence that Installer's existing company has minimum of 5 years continuous experience in application of specified materials. Submit list of at least five completed projects of similar scope and size, including:
 - Project name.
 - a. Owner's name.
 - b. Owner's Representative name, address, and telephone number.
 - c. Description of work.
 - d. Modified-bitumen materials used.
 - e. Project supervisor.
 - f. Total cost of roofing work and total cost of project.
 - g. Completion date.
- G. Manufacturer Certificate: Signed by roofing-system manufacturer, certifying that roofing system complies with specified requirements.
 1. Written approval by membrane manufacturer for use and performance of membrane over specified board insulation, including that materials supplied for project comply with requirements of cited ASTM standards. Approval should also indicate materials are suitable for ASTM E 108, Class 1A roof and meet specified wind uplift classification.
 2. Submit evidence of meeting performance requirements including applicable FMG assembly number or approved testing agency.
 3. Include all methods of attachment and attachment spacing for insulation and membrane system.
- H. CERTA Program Certificates for all workers who may use open flame torches.
- I. Certify that materials are free of asbestos.
- J. Sample Warranty: Copy of roofing-system manufacturer's warranty, stating obligations, remedies, limitations, and exclusions. Submitted with bid.
- K. Maintenance Data: For roofing system to include in maintenance manuals.
- L. Prior to installation of the roof system, provide a written report with fastener withdrawal values (pull out tests) per ANSI SPRI FX-1 on all projects to verify the suitability of decking to accept a mechanically fastened insulation and/or membrane roofing system.

- M. Following completion of Work, submit roofing-system manufacturer's inspection report of completed roofing installation and completed warranty; submit Installer's completed warranty.

1.5 QUALITY ASSURANCE

- A. **Manufacturer Qualifications:** A qualified manufacturer that is FM Approvals approved for membrane roofing system identical to that used for this Project with a minimum of 10 years of documented experience.
- B. **Installer Qualifications:** A qualified firm that is approved, authorized, or licensed by membrane roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty. Must have installations of specified materials in the local area in use for a minimum of 5 years.
- C. **Source Limitations:** Obtain components including roof insulation, fasteners, and adhesive for membrane roofing system from same manufacturer as membrane roofing or approved by membrane roofing manufacturer.
- D. **Exterior Fire-Test Exposure:** ASTM E 108, Class A; for application and roof slopes indicated, as determined by testing identical membrane roofing materials by a qualified testing agency. Materials shall be identified with appropriate markings of applicable testing agency.
- E. **Fire-Resistance Ratings:** Where indicated, provide fire-resistance-rated roof assemblies identical to those of assemblies tested for fire resistance per ASTM E 119 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- F. **Testing:** At Owners cost, Owner reserves the right to perform wind uplift testing of installed roof system per FM 1-52. Locations and quantities to be determined by Architect/Engineer. Initial test will be paid for by Owner, any additional testing required due to a failed test will be paid for by the Contractor.
- G. **Pre-Installation Testing:** Provide fastener withdrawal testing at metal deck areas per the latest version of ANSI/SPRI FX-1 testing procedures to verify fastener withdrawal resistance and identify fastener quantity and spacing
- H. **Open Flame or Torch Operator Certification:**
 - 1. All personnel or operators of open flame torches must be certified by the local municipality fire department through an approved training course or the Midwest Roofing Contractors Association CERTA Program. (Or Owners approved equal).
 - 2. The Contractor must submit the torch applicator certifications with the submittals for the project. No workers may use open flame torches without approved certifications submitted in advance.
- I. **Fumes And Environmental Considerations**
 - 1. **Air Intake:** The contractor will coordinate with the Roof Engineer and Owner to create a schedule for all rooftop air handler intake protection during the project.
 - 2. **Rooftop Air Intakes -** The Owner will close or otherwise adjust rooftop air intakes for minimum attraction of roofing material fumes from rooftop work.
 - 3. **Vent Covers -** Contractor will furnish plastic, charcoal, or other suitable covers for air intake vents, and shall install and remove such covers where requested to do so by the Owner

- J. Pre-installation Roofing Conference: Conduct conference at Project site. Contractor's site foreman, roofing-system manufacturer's technical representative, Roofing Installer, Owner's Representative, Architect, Structural Engineer, and installers whose work interfaces with or affects roofing, shall attend.
1. Site use, access, staging, and set-up location limitations.
 2. Review methods and procedures related to roofing installation, including manufacturer's written instructions. Including, but not limited to, the following: forecast weather conditions, storage and protection of materials prior to installation, surface preparation and pretreatment, environmental conditions.
 3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
 5. Review structural loading limitations of roof deck during and after roofing.
 6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.
 7. Review governing regulations and requirements for insurance and certificates if applicable.
 8. Review temporary protection requirements for roofing system and surrounding work during and after installation.
 9. Review roof observation and repair procedures after roofing installation.
 10. Reporting procedures.
 11. Related project details and interfaces with adjacent work.
 12. Testing and inspection requirements.
 13. Notification procedures for inspections.
 14. Documentation of modifications and repairs for project record.
 15. Documentation required for manufacturer's warranty.
 16. Governing regulations and requirements for insurance and certificates if applicable.
 17. Quality control and quality assurance plans.
 18. Safety and fire protection procedures.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components. Material storage procedures will be constantly monitored and strictly enforced.
- B. Use canvas tarps for protection of moisture-sensitive roofing materials. If plastic coverings are used, venting of each package is required. Roofing-system manufacturer's standard packaging and covering is not considered adequate weather protection.
- C. Select and operate material handling equipment in a safe manner, guarding against damage to existing construction or newly applied roofing and conforming to manufacturer's recommendations of handling and storage.
- D. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.
1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

- E. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation. Manufacturer's packaging is not considered adequate protection from moisture.
- F. Handle and store materials and equipment on structures to safe loading of structure at time and to avoid permanent deflection of deck. Conspicuously mark wet or damaged materials and promptly remove from Site. Materials, having been determined by the owner/owner's representative to be damaged, shall be immediately removed from the construction site and replaced at no cost to the owner.
- G. Store rolled asphalt based materials on ends only, unless otherwise required by roofing-system manufacturer's written instructions. Discard rolls that have been flattened, creased, or otherwise damaged.
- H. Do not store materials at locations where new roofing materials have been installed.
- I. Remove and replace materials that cannot be applied within stated shelf life.
- J. Flammable materials shall be stored in a cool, dry area away from sparks and open flames. Follow all precautions as outlined in manufacturer's Material Safety Data Sheets.

1.7 PROJECT CONDITIONS

- A. Safety:
 - 1. Take all necessary precautions regarding worker health and safety when using solvents and adhesives.
 - 2. Store flammable liquid and materials away from open sparks, flames and extreme heat.
 - 3. Take necessary precautions when using solvents and adhesives near fresh air intakes.
 - 4. Comply with all OSHA requirements for construction.
- B. Daily site cleanup shall be performed to minimize debris and hazardous congestion
- C. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions e.g. extreme temperature, high winds, high humidity and moisture, permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.
- D. Verify existing dimensions and details prior to installation of materials. Notify Architect/Engineer of conditions found to be different than those indicated in Contract Documents. Architect/Engineer will review situation and inform Contractor and Installer of changes.
- E. Comply with Owner's limitations and restrictions for site use and accessibility.
- F. Install materials in strict accordance with safety requirements required by roofing manufacturer, Material Safety Data Sheets, and local, state, and federal rules and regulations.
- G. Protection:
 - 1. Schedule installation sequence to limit access and utilization of the newly installed membrane for material storage, construction staging, mechanical and/or excessive foot traffic.

2. Protect roofing membrane, building surfaces, paving, and landscaping from traffic and roofing equipment. Provide temporary walkways constructed of plywood and set on protective material in traffic and construction areas.
 3. Restore or replace all work or materials damaged by the roofing operation.
 4. Remove protection materials upon completion of work.
 5. Adverse weather could have a detrimental effect on adhesives, general production efforts or the quality of the finished installation. Contact manufacturer for recommendations and acceptable tolerances.
- H. Daily seal: Ensure that moisture does not penetrate beneath any completed sections of the roof by sealing temporary roof terminations at the end of each work day and prior to the arrival of inclement weather. Inspect existing components for moisture intrusion along the temporary terminations at temporary cut-offs, tie-ins, and night seals after opening the seal on the next workday. Remove any wet, damp or moisture-damaged materials.
- I. All construction debris shall be removed from the construction site and legally dispose of offsite.
- 1.8 WARRANTY - ASSEMBLY #1
- A. Roofing Membrane Recover Warranty: Warrant the membrane roofing, metal flashing, and associated Work for 20 years from date of Substantial Completion. The warranty shall be term type, without deductibles or limitations on coverage amount.
- B. Warranty shall cover wind damage up to design wind speed indicated. Contractor shall purchase special "wind rider" as necessary to insure the 20- year roof warranty will provide total roof replacement for the wind loads specified with no exclusions.
- 1.9 WARRANTY - ASSEMBLY #2
- A. New Roofing Membrane and Lightweight Insulating Concrete Manufacturer's Warranty: Warrant the roof deck, membrane roofing, metal flashings, 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 roof system shall be a single source warranty to include lightweight insulating concrete deck, roof membrane, flashing, metal work, and other associated roofing materials. Repair of the system, including materials and labor, shall be done at no cost to the Owner.
- B. Warranty shall cover wind damage up to design wind speed indicated. Contractor shall purchase special "wind rider" as necessary to insure the 20- year roof warranties will provide total roof replacement for the wind loads specified with no exclusions.
- C. Additional items to be covered by the roof warranty include:
1. Actual resistance to heat flow through the roof deck shall remain at least 80 percent of the design thermal resistance, provided that the roof membrane is free of leaks. Should a roof leak occur, the insulating performance of the roof deck shall remain at least 80 percent of the design thermal resistance for 2 years following repair of the leak.
 2. The roof deck shall remain in a reroofable condition should the roof membrane require replacement, excluding damage caused by fastener pullout during removal of the membrane.
 3. Materials used in construction of the roof deck shall not cause structural damage resulting from expansion or thermal or chemical action.

- D. Make arrangements with the lightweight insulating concrete manufacturer to provide required inspections for issuance of warranty. Final warranty shall be submitted to Owner at time of Substantial Completion.

1.10 COORDINATION

- A. Prior to installation of materials, a pre-roofing conference should be held with the roofing contractor, and owner/owner's representative(s) to discuss the specified roofing system coordinate its proper application and the expectations of all parties involved. The authorized roofing contractor and the owner/owner's representative shall notify all parties a minimum of fourteen days prior to the meeting.
- B. Plan and coordinate the installation of the roofing system with other trades in such a manner to avoid membrane damage, keeping the complete installation weather tight and in accordance with all approved details and warranty requirements.
- C. Manufacturer shall be available to make recommendations necessary to ensure compliance with project specifications and specification alternatives due to unforeseen job conditions.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General Performance: Installed membrane roofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Membrane roofing and base flashings shall remain watertight.
- B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by membrane roofing manufacturer based on testing and field experience.
- C. Roofing System Design: Provide membrane roofing system that conforms to Miami-Dade Notice of Acceptable (NOA) or RoofNav FM tested/rated and approved systems. Roofing system is to be identical to systems that have been successfully tested by a qualified testing and inspecting agency to resist uplift pressure calculated according to ASCE/SEI 7 using design criteria indicated on Drawings.
- D. FM Approvals Listing: Provide membrane roofing, base flashings, and component materials that comply with requirements in FM Approvals 4450 and FM Approvals 4470 as part of a membrane roofing system. Roofing system must meet the design intent and wind uplift capabilities associated with the uplift rating requirements listed in this specification and that are listed in FM Approvals' "RoofNav" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals markings.
 - 1. Fire/Windstorm Classification: Class 1A-120.
 - 2. Hail Resistance Rating: SH.
- E. Attachment Criteria: Design in accordance with FM DS 1-29 and FM DS 1-49.
- F. UL Fire Hazards Classification: ASTM E 108, Class A.

- G. Energy Performance: Provide roofing system with initial Solar Reflectance Index not less than 82 when calculated according to ASTM E 1980 based on testing identical products by a qualified testing agency. Provide roofing membrane to meet applicable local Building Department requirements and 3-year aged solar reflectance greater than or equal to 0.55 and thermal emittance greater than or equal to 0.75 or 3-year aged solar reflectance index greater than or equal to 64, when tested according to one of the test methods listed below. A coated cap sheet is not allowed.
 - 1. Solar Reflectance Test Methods: ASTM C1549, ASTM E903, ASTM E1175, or ASTM E1918.
 - 2. Thermal Emittance Test Methods: ASTM C835, ASTM C1371, or ASTM E408.
- H. 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.
- I. 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.

2.2 MEMBRANE MATERIALS - ASSEMBLY #1 - MEMBRANE OVERLAYMENT

- A. Roofing Membrane: A roof membrane assembly consisting of two plies of a prefabricated, reinforced, homogeneous Styrene-Butadiene-Styrene (SBS) block copolymer modified asphalt membrane, applied over a prepared substrate. Reinforcement mats shall be impregnated/saturated and coated each side with SBS modified bitumen blend. The cross sectional area of the sheet material shall contain no oxidized or non-SBS modified bitumen. The roof system shall pass 500 cycles of ASTM D 5849 Resistance to Cyclic Joint Displacement (fatigue) at 14°F (-10°C). Passing results shall show no signs of membrane cracking or interply delamination after 500 cycles. The roof system shall pass 200 cycles of ASTM D 5849 after heat conditioning performed in accordance with ASTM D 5147. 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.
 - 1. Siplast Paradiene 20/30 FR BW roof system
- B. Modified Bitumen Base, Stripping, and Flashing Reinforcing Ply:
 - 1. Siplast Paradiene 20
- C. Modified Bitumen Finish Ply:
 - 1. Siplast Paradiene 30 FR BW.

2.3 MEMBRANE MATERIALS - ASSEMBLY #2 - NEW CONSTRUCTION

- A. Roofing Membrane: A roof membrane assembly consisting of two plies of a prefabricated, reinforced, homogeneous Styrene-Butadiene-Styrene (SBS) block copolymer modified asphalt membrane, applied over a prepared substrate. Reinforcement mats shall be impregnated/saturated and coated each side with SBS modified bitumen blend and coated one side with a torch grade SBS bitumen blend adhesive layer. The adhesive layer shall be manufactured using a process that embosses the surface with a grooved pattern to provide optimum burn-off of the plastic film and to maximize application rates. The cross sectional area of the sheet material shall contain no oxidized or non-SBS modified bitumen. The roof system shall pass 500 cycles of ASTM D 5849 Resistance to Cyclic Joint Displacement (fatigue) at 14°F (-10°C). Passing results shall show no signs of membrane cracking or interply delamination after 500 cycles. The roof system shall pass 200 cycles of ASTM D 5849 after heat conditioning performed in accordance with ASTM D 5147. 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.
1. Siplast Paradiene 20 TG/30 FR TG torchable roof system
- B. Modified Bitumen Base and Stripping Ply:
1. Siplast Paradiene 20 TG.
- C. Modified Bitumen Finish Ply:
1. Siplast Paradiene 30 FR TG BW.

2.4 FLASHING MATERIALS

- A. Membrane Flashing Assembly: A flashing membrane assembly consisting of a prefabricated, fiberglass scrim-mat reinforced, Styrene-Butadiene-Styrene (SBS) block copolymer modified asphalt membrane with a continuous, channel-embossed metal-foil surfacing. A low softening point asphalt shall be incorporated into the membrane between the metal foil surfacing and the SBS modified bitumen asphalt membrane, at the channels, in order to preclude foil delamination during daily thermal cycling.
1. Siplast Veral Aluminum.
- B. Liquid Flashing System: PMMA flashing system by the roofing manufacturer:
1. Siplast Parapro

2.5 AUXILIARY ROOFING MATERIALS

- A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with roofing membrane.
1. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.
- B. Membrane Cold Adhesive: A blend of special adhesive asphalts and high-flash, quick drying solvents that meets or exceeds ASTM D 4479, TYPE II requirements.
1. Siplast PA-311 R Adhesive.
- C. Asphalt Primer: ASTM D 41.

- D. Mastic Sealant: Polyisobutylene, plain or modified bitumen; non hardening, non migrating, non skinning, and nondrying.
- E. Flashing Cement: ASTM D 4586, asbestos free, of consistency required by roofing-system manufacturer for application. Use for sealing laps in membrane or base flashing, surface or stripping flashing at equipment penetrations and drains, or repairs to membrane or flashing.
- F. Metal Flashing Sheet: As specified in Division 07 Section "Sheet Metal Flashing and Trim."
- G. Lead flashing for roof drains: 4-pound lead.
- H. Roofing Granules: Ceramic-coated roofing granules, No. 11 screen size with 100 percent passing No. 8 sieve and 98 percent of mass retained on No. 40 sieve, color to match roofing membrane.
- I. Termination Bar: Roofing-system manufacturer's standard; aluminum bars, approximately 1-inch wide by 1/8-inch thick; with predrilled holes 6 inches on center.
- J. Sealant (low slope applications): A moisture-curing, self-leveling elastomeric sealant designed for roofing applications. The sealant shall be approved by the roof membrane manufacturer for use in conjunction with the roof membrane materials.
 - 1. Siplast PS-209 Elastomeric Sealant.
- K. Sealant (vertical and sloped applications): A moisture-curing, non-slump elastomeric sealant designed for roofing applications. The sealant shall be approved by the roof membrane manufacturer for use in conjunction with the roof membrane materials.
 - 1. Siplast PS-715 NS Elastomeric Sealant.
- L. Miscellaneous Accessories: Provide those recommended by roofing system manufacturer.

2.6 FASTENERS

- A. Fasteners for reattachment of existing roof system (Assembly #1): Insulation fasteners and plates shall be FM Approved, and/or approved by the manufacturer of the primary roofing products. The insulation fasteners shall provide attachment required to meet the specified uplift performance and to restrain the insulation panels against the potential for ridding. The fastening pattern for each insulation panel to be used shall be as recommended by the insulation manufacturer and approved by the manufacturer of the primary roofing products. Acceptable insulation fastener manufacturers for specific deck types are listed below.
 - 1. Metal Decks: Insulation mechanical fasteners for metal decks shall be factory coated for corrosion resistance. The fastener shall conform meet or exceed Factory Mutual Standard 4470 and when subjected to 30 Kesternich cycles, show less than 15% red rust. Acceptable insulation fastener types for metal decks are listed below.
 - a. A fluorocarbon coated screw type roofing fastener having a minimum 0.220 inch thread diameter. Plates used in conjunction with the fastener shall be a metal type having a minimum 3 inch diameter, as supplied by the fastener manufacturer.
 - 1) Siplast Parafast Fastener.
- B. Base Sheet Fasteners (Assembly #2): Base sheet fasteners shall be approved by the manufacturer of the primary roofing products. Acceptable base sheet fasteners for specific substrate types are listed below.

1. Lightweight Concrete Substrates: A single unit, precision formed, electro zinc coated steel fastener having a 2.7 inch diameter rib reinforced cap and 1.7 inch long rectangular legs, designed to expand when fully driven into the lightweight concrete. Fasteners for lightweight concrete shall meet FM Standard 4470 requirements for corrosion resistance.
 - a. Siplast Zono-tite Fasteners.

- C. Flashing Reinforcing Sheet Fasteners for Wood/Plywood Substrates to Receive Flashing Coverage: Fasteners shall be approved by the manufacturer of the primary roofing products. Acceptable fasteners for specific substrate types are listed below.

1. Wood/Plywood Substrates: A 12 gauge, spiral or annular threaded shank, zinc coated steel roofing fastener having a minimum 1 inch head.
 - a. Square Cap by Maze Nails; Peru, IL.
 - b. Simplex Cap Nail by Simplex Nails, Inc., Americus, GA.

2.7 WALKWAYS

- A. Walkway Pads: Same granulated cap sheet product as used in the field area of the roof and as follows: Granule Color: Gray or White.
 1. Size: As standard with manufacturer.
 2. Provide walk pads manufactured in sizes required, without cutting or trimming.
 3. Provide walk pads at point of roof access, and at service points of roof mounted equipment requiring periodic maintenance.
 4. Protection pads shall have rounded corners and extend minimum 4-inches beyond edge of overlying element.
 5. Provide new protection pads under pipe supports, at HVAC and mechanical access points, in front of roof top doors and openings.
 6. In addition to locations specified herein, provide walk pads where indicated on drawings.

2.8 FACTORY FABRICATED FASCIA

- A. Fascia components shall be factory formed according to the requirements of the membrane manufacturer and labeled with the roofing manufacturer's logo. The fascia system shall consist of the following components:
 1. An extruded aluminum anchor bar with pre-punched slotted fastening holes, secured using stainless steel hex head fasteners provided by the manufacturer.
 2. Pre-formed EPDM anchor bar spacers.
 3. A factory formed exterior fascia, fabricated from minimum 0.040 aluminum, having a coil coated fluoropolymer finish.
 4. Factory formed folded miters and end caps.
- B. Product: Siplast Paraguard Extruded Edge AT System.

2.9 SHEETMETAL FABRICATIONS

- A. Fabricate the following metal components from 3003 S alloy plain sheet aluminum meeting ASTM B 209 specifications having a thickness of 0.040 inches. The metal shall be primed and coated with a 70% fluoropolymer coating of 1.0 ± 0.1 mil total dry film thickness. Color as indicated.

1. Metal Coping Cap: Fabricate coping componets to comply with ANSI/SPRI/ES-1 and current local International Building Codes. Fabricate the metal cap with a width to adequately cover the top of the parapet wall; incorporating a minimum 4 inch face on each side. The bottom edge of each continous cleat and fascia shall have a minimum 3/4 inch drip edge, hemmed and formed at 30 degrees and shall be fabricated for attachment to a continuous cleat at each side of the parapet. Fabricate components in maximum 10 foot sections. Provide fabricated corners to extend a minimum of 1 foot in either direction from the corner. All joints shall have minimum 4 in wide cover plates.
2. Reglet Counterflashing: Fabricate metal counterflashings at existing masonry walls in a 2 component configuration.
 - a. Fabricate the counterflashing pocket receiver to accept the counterflashing and fit into the masonry reglet a minimum of 1 1/2 inches. Notch the flashing receiver at all corners and joints.
 - b. Fabricate the counterflashing to fit into the pocket receiver, using button punches in the counterflashing to secure the flashing. Fabricate the bottom edge of the counterflashing to have a minimum 1/2 inch drip edge, formed at 45 degrees. Fabricate the counterflashing in maximum ten foot sections and notch inside corners and joints and seam outside corners.
3. Scupper Inserts: Fabricate scupper sleeves to fit tightly inside of through-wall scupper openings and extend a minimum of 1 inch beyond the outside parapet. The sleeve shall have a minimum 4 inch flange with four sides surrounding the scupper opening. Fasten and solder all metal laps.
4. Surface-Mounted Counterflashing: A two-component assembly, having a minimum four (4) inch fascia; covering the base flashing. The fascia shall connect into a wall secured, termination bar/snap lock component.

PART 3 - EXECUTION

3.1 GENERAL

- A. The "Authorized" roofing contractor is responsible for ensuring appropriate system specific addendums from manufacturer.
- B. The roofing contractor is responsible for providing a suitable substrate surface for the proper installation of the Roofing System, roof insulation and specified components.
- C. Application of the roofing system constitutes an agreement that the roofing contractor has inspected and found the substrate suitable for the installation of the Roofing System.
- D. The roofing contractor is responsible for coordinating the installation to ensure that the system remains watertight at the end of each working day.

3.2 SUBSTRATE EXAMINATION

- A. The roofing contractor is responsible for verifying that the deck condition and/or existing roof construction is suitable for the specified installation of the Roofing System.
- B. Examine substrates, areas, and conditions, with Installer present, for compliance with the following requirements and other conditions affecting performance of roofing system:
 1. Verify that roof openings and penetrations are in place and curbs are set and braced and that roof drain bodies are securely clamped in place.

2. Verify that wood cants, blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
 3. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Division 05 Section "Steel Decking."
 4. Verify that minimum concrete drying period recommended by roofing system manufacturer has passed.
 5. Verify that concrete substrate is visibly dry and free of moisture. At a minimum, test for capillary moisture by plastic sheet method according to ASTM D 4263-83. Additional testing may be required.
 6. Verify that concrete-curing compounds that will impair adhesion of roofing components to roof deck have been removed.
 7. The application of adhesives directly to structural concrete; existing smooth and/or granular BUR materials may require sealing or priming with an accepted asphalt primer prior to application.
 8. Verify that steel deck is securely fastened with no projecting fasteners and with no adjacent units in excess of 1/16 inch (1.6 mm) out of plane relative to adjoining deck.
 9. Examine surfaces for low areas that will not drain properly, foreign material, ice, wet insulation, unevenness or any other defect which would prevent the proper execution and quality application of the Roofing System as specified
- C. Prepared substrate shall be smooth, dry, and free of debris and/or any other irregularities which would interfere with the proper installation of the Roofing System. Proceed with installation only after unsatisfactory conditions have been corrected.
- D. Installer and roofing-system manufacturer's representative shall examine substrate to ensure that it is properly prepared and ready to receive roofing system. Roofing-system manufacturer's representative shall report in writing to Installer and Architect/Engineer conditions which will adversely affect roofing-system installation or performance. Do not proceed with roofing-system installation until these conditions have been corrected and reviewed by Architect/Engineer.
- E. Provide fastener withdrawal values (pull out tests) per ANSI SPRI FX-1 on all projects to verify the suitability of decking to accept a mechanically fastened insulation and/or membrane roofing system.

3.3 COORDINATION

- A. Coordinate Work to ensure that roof deck, roofing materials and building interior are kept continuously dry and that continuous, watertight, new roofing system is provided. Coordinate:
1. With Owner's Representative.
 2. With other trades to avoid or minimize work on, or in immediate vicinity of, installation in progress and completed new roofing.
 3. To avoid or minimize adverse effects on completed new roofing.
 4. Ensure that drains are operational at end of each workday or if precipitation is forecast.

3.4 PREPARATION

- A. General: Sweep or vacuum all surfaces, removing all loose aggregate and foreign substances prior to commencement of roofing.
- B. Mechanical Attachment of the Existing Roof System (Assembly #1): Mechanically fasten the existing roof system through the existing lightweight insulating deck and anchor into the metal deck using indicated fasteners at a specified length with 3-inch plates. Fasten each sheet every 24 inches through the laps and stagger fasten the remainder of the sheet in 1 row with fasteners on 24-inch centers.

3.5 ROOF MEMBRANE INSTALLATION - GENERAL

- A. Membrane Application: Apply roofing in accordance with roofing system manufacturer's instructions and the following requirements. Application of roofing membrane components shall immediately follow application of base sheet and/or insulation as a continuous operation.
- B. Membrane Adhesive Application: Apply cold adhesive in a smooth, even, continuous layer without breaks or voids at the rate of 1 1/2 to 2 1/2 gallons per square.
- C. Bitumen Consistency: Cutting or alteration 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.
 - 1. Apply all layers of roofing perpendicular to the slope of the deck.
 - 2. Fully bond the base ply to the prepared substrate, utilizing minimum 3 inch side and end laps. Apply each sheet directly behind the cold adhesive or torch applicator. Cut a dog ear angle at the end laps on overlapping selvage edges. Using a clean trowel, apply top pressure to top seal T-laps immediately following sheet application. Stagger end laps a minimum of 3 feet.
 - 3. Fully bond the finish ply to the base ply, utilizing minimum 3 inch side and end laps. Apply each sheet directly behind the cold adhesive or torch applicator. Stagger end laps of the finish ply a minimum 3 feet. Cut a dog ear angle at the end laps on overlapping selvage edges. Using a clean trowel, apply top pressure to top seal T-laps immediately following sheet application. Stagger side laps of the finish ply a minimum 12 inches from side laps in the underlying base ply. Stagger end laps of the finish ply a minimum 3 feet from end laps in the underlying base ply.
 - 4. Heat weld all side and end laps of the modified bitumen plies during each day's application in areas where standing water accumulates.
- E. Granule Embedment: Broadcast mineral granules over all bitumen/adhesive overruns on the finish ply surface to ensure a monolithic surface color.
- F. Flashing Application: Flash masonry parapet walls and curbs using the metal foil flashing membrane. 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 by application of asphalt primer; allowing primer to dry thoroughly. Torch apply the metal foil-faced flashing into place using three foot widths (cut off the end of roll) always lapping the factory selvage edge. Extend the flashing sheet a minimum of 6 inches beyond the toe of the cant over the prepared surface of the finish ply and up the wall to the desired flashing height. Stagger the laps of the metal foil flashing layer from lap seams in the finish ply layer. Exert pressure on the flashing sheet during application to ensure complete contact with the prepared wall/roof surfaces, preventing air pockets. Check and seal all loose laps and edges. Nail the top edge of the flashing on 9 inch centers.

3.6 RELATED COMPONENTS - INSTALLATION

- A. Factory Fabricated Fascia (Paraguard Extruded Edge AT):

1. After completion of the installation of the roofing membrane plies, apply a three inch wide, 1/4 inch thick band of the roofing manufacturer's specified mastic or sealant to the underside of the flange of the extruded aluminum anchor bar. Install the anchor bar joint spacer into the end of the extruded aluminum anchor bar to allow the next section to fit properly over the anchor bar joint spacer. Secure the extruded aluminum anchor bar to the perimeter nailer in accordance with the roof system manufacturer's installation instructions.
 2. Beginning again at the corners, hook the top of the exterior fascia onto the top of the extruded aluminum anchor bar and apply slight pressure downward until the fascia engages over the bottom of the extruded aluminum anchor bar. Position the next section to overlap the preceding section approximately 1 inch at the notches provided. Install sections of the fascia cover from right to left as viewed from the rooftop engaging the fascia cover over the anchor bar in the same method as previously described.
- B. Lead Pipe Flashings: Completely prime the lead flanges and allow to dry prior to installation. Set the flange in mastic around the penetration, and strip-in the flange using the stripping ply material, extending a minimum of 4 inches beyond the edge of the flange. Terminate the finish ply at the flange-sleeve juncture of the pipe flashing.
- C. Liquid Flashing System: Install the specified liquid-applied flashing system in accordance with the membrane system manufacturer's printed installer's guidelines and other applicable written recommendations as provided by the manufacturer.
- D. Flanged Metal Flashings: Set the flange of the new metal flashings in a full bed of plastic cement and secure the flange. Strip-in the flange using stripping-ply material, extending a minimum of 4 inches beyond the edge of the flange. Terminate the finish ply at the flange-sleeve juncture of the pipe flashing.
- E. Roof Drains: Install the finish ply to extend beneath the clamping ring seal, setting the finish ply in a full bed of plastic cement 6 inches beyond the perimeter of the drain bowl. Reinstall the clamping rings with new stainless-steel bolts and washers and reinstall strainers, ensuring that the clamping ring is secured using the torque specified by the drain manufacturer.
- 3.7 EQUIPMENT AND EXPANSION JOINT CURBS
- A. Refer to general base flashing installation requirements and the following additional procedures.
- B. At wood curbs for equipment and expansion joint assemblies, extend base ply of flashing membrane up and over top of curb, and secure with nails to blocking.
- C. Extend flashing membrane sheet up vertical surface of curb and terminate at top edge as shown on Drawings. For expansion joint locations, seal top edge of flashing sheet with mastic. Securement shall be by fasteners that attach expansion joint assembly to curbs.
- D. For curbs where integral sheet metal flashing is used but not attached to face of curb, install termination bar through flashing sheet as shown on Drawings with fasteners at 6 inches on center
- E. Equipment Penetrations. Flash per Drawing details or per roofing-system manufacturer's recommendations.
- F. Prime flange of sheet-metal flashing, allow to dry, and set in modified-bitumen adhesive.
- G. Apply sealant at base flashing termination on sheet metal flashing.

3.8 WALKWAY INSTALLATION

- A. Walkway Pads: Install walkway pads using units of size indicated or, if not indicated, of manufacturer's standard size according to walkway pad manufacturer's written instructions.
 - 1. Fully adhere or torch apply walkway pads.
- B. Use only full-size units, except partial units at corners if necessary to provide neat, finished appearance.
- C. Provide 2 inches minimum between adjacent units. Extend walkway 6 inches minimum beyond edges of equipment or supports.
- D. Sweep loose surfacing material from walkway locations.
- E. Cap Sheet Strips: Set strips, in lengths not exceeding 10 feet, in heavy application of asphalt mastic or same bitumen used to install roofing system, in accordance with recommendations of walkway and roofing-system manufacturers. Walkways shall be fully adhered to roofing cap sheet.

3.9 FIELD QUALITY CONTROL

- A. Roof cement shall not be incorporated into the roof membrane or flashing system.
- B. Architect/Engineer will inspect roofing system at various stages of construction and at completion.
- C. Testing Agency: A qualified testing agency shall be engaged to perform tests and inspections and to prepare test reports.
- D. Test Cuts: Test specimens will be removed to evaluate problems observed during quality-assurance inspections of roofing membrane as follows:
 - 1. Approximate quantities of components within roofing membrane will be determined according to ASTM D 3617.
 - 2. Test specimens will be examined for interply voids according to ASTM D 3617 and to comply with criteria established in Appendix 3 in ARMA/NRCA's "Quality Control Guidelines for the Application of Polymer Modified Bitumen Roofing."
 - 3. Repair areas where test cuts were made according to roofing system manufacturer's written instructions.
- E. Infrared Survey: If roofing cap sheet is not installed immediately after the smooth surfaced base sheet is installed (Phased Construction), contractor shall provide an infra-red survey of entire roof area. Survey shall be performed by organization that is approved by the Architect. Infra-red survey and subsequent report shall be performed prior to the installation of the roofing cap sheet.
- F. Manufacturer's Inspections: Arrange for the roofing systems manufacturer to provide qualified technical personnel for onsite observation and instruction full time at beginning of membrane installation to establish project standard and thereafter as the manufacturer deems necessary, but not less than 1 time every two weeks when roofing membrane and related work is being performed. A field observation report from each visit will be generated and submitted to the Engineer within 48 hours of the visit.

G. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion.

1. Notify Architect and Owner 48 hours in advance of date and time of inspection.

H. Roofing system will be considered defective if it does not pass tests and inspections.

1. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

2. Repair or remove and replace components of roofing system where test results or inspections indicate that they do not comply with specified requirements.

3.10 PROTECTING AND CLEANING

A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

D. Accompany the manufacturer's technical inspector, and assist with equipment and workmen if necessary to provide access to the roof. Correct all defects noted during the inspection.

3.11 TEMPORARY SEALS

A. At the end of each working day or at the sign of rain, install temporary, 100% watertight seal(s) where the completed new roofing adjoins the uncovered deck or existing roof surface.

B. The authorized roofing contractor shall create and maintain the temporary seal in such a manner to prevent water from traveling beneath the new and/or existing roof system.

C. The use of plastic roofing cement is permissible when sealing to an existing built up roof.

D. If water is allowed to enter beneath the newly completed roofing, the affected area(s) shall be removed and replaced at no additional expense to the building owner.

E. Prior to the commencement of work, cut out and remove all contaminated membrane, insulation, roof cement or sealant and properly dispose off site.

3.12 LIGHTNING PROTECTION

A. The installation of lightning protection must be coordinated with the authorized roofing contractor, certified lightning contractor and the building owner.

B. The lightning protection must be installed in such a manner that base plates, air terminals and cables do not penetrate the roofing membrane without the use of pre-approved flashing details.

- C. Cables and air terminals may be attached to the membrane using base plates and an approved construction adhesive or by welding intermittent strips of membrane over the base plates and cables to the roofing. Contact manufacturer for specific adhesive recommendations.
- D. Recommendations regarding the selection of adhesives or alternative affixing of lightning protection systems to the membrane does not in any way imply a warranty covering their performance or ability of the adhesives to remain affixed to the membrane.

3.13 COMPLETION

- A. Remove any and all debris, excess materials and scrap of any kind from the roof and surrounding premises prior to demobilization.
- B. Inspect all field welds, detailing and terminations to ensure a 100% the watertight installation.

3.14 WARRANTY INSPECTION

- A. Upon completion of the project, the authorized roofing contractor shall complete and submit the Project Completion Notice to manufacturer.
- B. Upon receipt of the notice of completion, a manufacturer's representative will schedule an inspection with a representative of the authorized roofing contractor to thoroughly review the installation and verify compliance with the manufacturer's requirements.
- C. Any corrections or modifications necessary for compliance with the specifications and acceptance for warranty (punch list) will be noted on the Final Inspection for Warranty Form.
- D. Upon completion of all punch list items and final acceptance of the installation, a warranty as authorized by the approved manufacturer Notice of Award and Warranty Request Form will be issued.

3.15 ROOFING INSTALLER'S WARRANTY

- A. WHEREAS <Insert name> of <Insert address>, herein called the "Roofing Installer," has performed roofing and associated work ("work") on the following project:
 - 1. Owner: <Insert name of Owner>.
 - 2. Address: <Insert address>.
 - 3. Building Name/Type: <Insert information>.
 - 4. Address: <Insert address>.
 - 5. Area of Work: <Insert information>.
 - 6. Acceptance Date: <Insert date>.
 - 7. Warranty Period: <Insert time>.
 - 8. Expiration Date: <Insert date>.
- B. AND WHEREAS Roofing Installer has contracted (either directly with Owner or indirectly as a subcontractor) to warrant said work against leaks and faulty or defective materials and workmanship for designated Warranty Period,
- C. NOW THEREFORE Roofing Installer hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period he will, at his own cost and expense, make or cause to be made such repairs to or replacements of said work as are necessary to correct faulty and defective work and as are necessary to maintain said work in a watertight condition.

- D. This Warranty is made subject to the following terms and conditions:
1. Specifically excluded from this Warranty are damages to work and other parts of the building, and to building contents, caused by:
 - a. lightning;
 - b. peak gust wind speed exceeding 110 mph;
 - c. fire;
 - d. failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;
 - e. faulty construction of parapet walls, copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the work;
 - f. vapor condensation on bottom of roofing; and
 - g. activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Owner.
 2. When work has been damaged by any of foregoing causes, Warranty shall be null and void until such damage has been repaired by Roofing Installer and until cost and expense thereof have been paid by Owner or by another responsible party so designated.
 3. Roofing Installer is responsible for damage to work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of work.
 4. During Warranty Period, if Owner allows alteration of work by anyone other than Roofing Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty shall become null and void on date of said alterations, but only to the extent said alterations affect work covered by this Warranty. If Owner engages Roofing Installer to perform said alterations, Warranty shall not become null and void unless Roofing Installer, before starting said work, shall have notified Owner in writing, showing reasonable cause for claim, that said alterations would likely damage or deteriorate work, thereby reasonably justifying a limitation or termination of this Warranty.
 5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a promenade, work deck, spray-cooled surface, flooded basin, or other use or service more severe than originally specified, this Warranty shall become null and void on date of said change, but only to the extent said change affects work covered by this Warranty.
 6. Owner shall promptly notify Roofing Installer of observed, known, or suspected leaks, defects, or deterioration and shall afford reasonable opportunity for Roofing Installer to inspect work and to examine evidence of such leaks, defects, or deterioration.
 7. This Warranty is recognized to be the only warranty of Roofing Installer on said work and shall not operate to restrict or cut off Owner from other remedies and resources lawfully available to Owner in cases of roofing failure. Specifically, this Warranty shall not operate to relieve Roofing Installer of responsibility for performance of original work according to requirements of the Contract Documents, regardless of whether Contract was a contract directly with Owner or a subcontract with Owner's General Contractor.
- E. IN WITNESS THEREOF, this instrument has been duly executed this <Insert day> day of <Insert month>, <Insert year>.
1. Authorized Signature: <Insert signature>.
 2. Name: <Insert name>.
 3. Title: <Insert title>.

END OF SECTION

SECTION 07 62 00 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Fabricated sheet metal items, including flashings, and counterflashings not identified in the roofers scope of work. See section 07 52 01 for roofing flashings.
- B. Reglets and accessories.
- C. Sheet metal splash pans.

1.2 PERFORMANCE REQUIREMENTS

- A. General Performance: Metal flashing and trim assemblies shall comply with performance requirements without failure due to defective manufacture, fabrication, installation, or other defects in construction.
- B. Structural Performance: Provide metal flashing and trim assemblies capable of withstanding the effects of the following loads and stresses within limits and under conditions indicated, based on testing according to ASTM E 330:
 - 1. Meet load requirements in accordance with IBC-2015 , ASCE 7-10, and the following structural design loads. The System will have been successfully tested for wind, blast and impact loads as integral part of entire roofing assembly.
 - 2. Wind Load: As indicated.

1.3 SUBMITTALS

- A. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.
- B. Samples: Submit two samples 3 by 5 inch in size illustrating metal finish and color.

1.4 QUALITY ASSURANCE

- A. Perform work in accordance with SMACNA Architectural Sheet Metal Manual requirements and standard details, except as otherwise indicated.
- B. Fabricator and Installer Qualifications: Company specializing in sheet metal work with 5 years of documented experience.

1.5 PRE-INSTALLATION CONFERENCE

- A. Convene one week before starting work of this section.
- B. Review preparation and installation procedures and coordinating and scheduling required with related work.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.
- B. Prevent contact with materials that could cause discoloration or staining.

1.7 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Work of this section shall be included in contractors warranty as specified in section 07 52 01.
- C. Manufacturer's Finish Warranty:
 - 1. Manufacturer's standard 20 year Kynar 500 or Hylar 5000 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.
- D. Contractor's Sheet Metal Warranty:
 - 1. Contractor shall warrant the sheet metal work and related work to be free from defects in workmanship and materials, and that the metal flashings will be and remain watertight, for a period of five (5) years from date of Substantial Completion.
 - 2. Defects shall include, but not be limited to:
 - a. Leaking water or bitumen within building or construction.
 - b. Becoming loose from substrate.
 - c. Loose or missing parts.
 - d. Finish failure as defined above.

PART 2 - PRODUCTS

2.1 SHEET MATERIALS

- A. Siplast Paraguard edge metal: minimum 0.02 inch thick base metal, shop pre-coated with PVDF coating.
 - 1. Color as indicated..
- B. Pre-Finished Aluminum: ASTM B 209; 0.040 inch thick; plain finish shop pre coated with fluoropolymer coating of color as indicated.
 - 1. Fluoropolymer Coating: Superior Performance Organic Finish, AAMA 2605; multiple coats, thermally cured fluoropolymer finish system in accordance with section 05 05 00.
- C. Lead: ASTM B 749, 2.5 lb/sq ft thick.
- D. Stainless Steel: ASTM A 666 Type 304, soft temper, 0.025 inch thick minimum; smooth No. 4 finish.

2.2 ACCESSORIES

- A. Fasteners: Same material and finish as flashing metal, with soft neoprene washers.
- B. Underlayment: ASTM D 2178, glass fiber roofing felt.
- C. Slip Sheet: Rosin sized building paper.
- D. Primer: Zinc chromate type.
- E. Protective Backing Paint: Zinc molybdate alkyd.
- F. Sealant: Type silicone specified in Section 07 90 05.
- G. Plastic Cement: ASTM D 4586, Type I.
- H. Reglets: Surface mounted type, galvanized steel.
- I. Solder: ASTM B 32; Sn50 type.

2.3 FABRICATION

- A. Form sections true to shape, accurate in size, square, and free from distortion or defects.
- B. Fabricate cleats of same material as sheet, minimum 4 inches wide, interlocking with sheet.
- C. Form pieces in longest possible lengths.
- D. Hem exposed edges on underside 1/2 inch; miter and seam corners.
- E. Form material with flat lock seams, except where otherwise indicated. At moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.
- F. Fabricate corners from one piece with minimum 18 inch long legs; seam for rigidity, seal with sealant.
- G. Fabricate vertical faces with bottom edge formed outward 1/4 inch and hemmed to form drip.
- H. Fabricate flashings to allow toe to extend 2 inches over roofing edge. Return and brake edges.
- I. Pipe Box Cover: 24 gauge stainless steel.
- J. Heat Exhaust Curbs and Hoods: 22 gauge stainless steel.
- K. Pipe Box Cover: 24 gauge stainless steel.
- L. Heat Exhaust Curbs and Hoods: 22 gauge stainless steel.
- M. Expansion Joint Cover: Minimum 24 gauge stainless steel. (Provide pre-finished galvanized metal at perimeter edge end termination.
- N. Fabricated Items:
 - 1. Metal Through-Wall Flashings: (Minimum 10 foot lengths)

- a. Through wall Receiver Tray: Minimum 24 gauge stainless steel, through wall receivers shall not extend past the face of the exterior wall veneer more than 3/4 inch.
 - b. Removable Counterflashing: Minimum 24 ga. stainless steel.
 2. Perimeter Edge Fascia Flashings:
 - a. Minimum 0.040 inch thick pre-finished aluminum formed in maximum ten (10) foot lengths, with 6 inch wide cover plates of same profile, 4 inch flange, maximum 7 inch fascia, 3/4 inch gravel stop. Min. 0.50 continuous cleat and .040 pre-finished gravel guard. Siplast Paraguard edge metal to provide 20 year roof warranty.
 - b. Provide expansion slip joints at maximum 20 feet on center.
 - c. Shop fabricate all interior and exterior corners. Fabricate exterior corners with 18 inch minimum to four (4) foot maximum legs. Lap, rivet, and seal prior to delivery to jobsite.
 3. Fabricate to sizes and dimensions as indicated on drawings with a minimum 1 inch coverage past top of wall. Refer to SMACNA Fig. 2-5A.
 4. Continuous Cleats: Continuous strips, same material and profile, minimum one gauge heavier of item which cleats attach.
- O. Pitch Pans: Minimum 24 gauge stainless steel

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.
- B. Verify roofing termination and base flashings are in place, sealed, and secure.

3.2 PREPARATION

- A. Install starter and edge strips, and cleats before starting installation.
- B. Install surface mounted reglets true to lines and levels. Seal top of reglets with sealant.
- C. Back paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mil.

3.3 INSTALLATION

- A. Insert flashings into reglets to form tight fit. Secure in place with lead wedges. Seal flashings into reglets with sealant.
- B. Secure flashings in place using concealed fasteners.
- C. Apply plastic cement compound between metal flashings and felt flashings.
- D. Fit flashings tight in place. Make corners square, surfaces true and straight in planes, and lines accurate to profiles.
- E. Seal metal joints watertight.

- F. Solder metal joints for full metal surface contact. After soldering, wash metal clean with neutralizing solution and rinse with water.
- G. Set splash pans under downspouts.

3.4 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for field inspection requirements.
- B. Inspection will involve surveillance of work during installation to ascertain compliance with specified requirements.
- C. Refer to section 04 20 00 for inspection of foundation sill flashing at masonry.

3.5 SCHEDULE

- A. Fascia and Cornices: Prefinished aluminum, color as selected.
- B. Gutters and Downspouts: Prefinished aluminum, 0.050 inch
- C. Scuppers: Prefinished aluminum
- D. Sill and Ledge Flashings: Prefinished aluminum
- E. Sheet Metal Roof Expansion Joint Covers Stainless Steel
- F. Counterflashings at Curb-Mounted Roof Items, including skylights and roof hatches: prefinished aluminum
- G. Roofing Penetration Flashings, for Pipes, Structural Steel, and Equipment Supports: Lead

END OF SECTION

SECTION 07 65 00 - FLEXIBLE FLASHING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Provide flexible membrane flashing to surfaces indicated on drawings or required to divert or otherwise prevent moisture from entering into or through building envelope.

1.2 RELATED SECTIONS

- A. Section 07 25 00 - Weather Barriers: Integration of flexible flashings into weather barrier assemblies.
- B. Section 07 62 00 - Sheet Metal Flashing and Trim: metal flashing
- C. Section 07 90 05 - Joint Sealants
- D. All Sections of Work adjacent to or affected by Work of this Section.

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, lead or PCB's.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain Self-Adhering Door and Window Flashing and Thru-Wall Membrane Flashing from same manufacturer furnishing air barrier materials specified in Section Section 07 25 00 - Weather Barriers.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with requirements, manufacturers and products listed are approved for use on the Project.
 - 1. Self-Adhering Door and Window Flashing (Type A):
 - a. W. R. Grace & Co., "Vycor Plus"
 - b. Fortifiber Building Systems, "FortiFlash 25"
 - c. Protecto Wrap "BT25XL"
 - d. Tamko Waterproofing, "Window and Door Wrap"
 - 2. Thru-Wall Membrane Flashing (Type B):

- a. Tamko Waterproofing, "TW-Thru Wall Flashing"
 - b. Carlisle, "CCW-705-TWF"
 - c. Fortifiber Building Systems, "FortiFlash 40"
 - d. W. R. Grace & Co., "Perm-A-Barrier"
 - e. Henry Company, "Blueskin TWF"
 - f. Nervastral, Inc., "Bitu-Rap"
 - g. W.R. Meadows, "Air-Shield"
 - h. York Manufacturing, Inc., "York Seal ES"
3. Laminated Copper (Type C):
- a. Asphalt Laminated Copper Flashing:
 - 1) Advanced Building Products, Inc.
 - 2) Hohmann & Barnard, Inc.
 - 3) Sandell Manufacturing Company, Inc.
 - 4) Manufacturing, Inc.
 - b. Asphalt-free Copper Fabric Flashing (Contractors Option):
 - 1) 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.
 - 2) Approved Product/Manufacturer: Multi-flash 500 as manufactured by York Manufacturing, Inc.; or Copper-Tuff as manufactured by Hohmann & Barnard, Inc. (No other substitutions)
4. Metal-clad Flexible Flashing (Type D):
- a. Henry HE200AM – Metal Clad Weather Barrier

2.2 MATERIALS

- A. Self-Adhering Flashing (Type A):
1. Self-Adhered Flexible Flashing: 25-mil, rubberized asphalt adhesive reinforced flashing with a high density cross laminated polyethylene film.
 2. Primer: manufacturer's compatible primer from same manufacturer as membrane.
- B. Thru-Wall Membrane Flashing (Type B):
1. Self-Adhered Flexible Flashing: 40-mil, rubberized asphalt adhesive reinforced flashing with a high density cross laminated polyethylene film.
 2. Primer: manufacturer's compatible primer from same manufacturer as membrane.
 3. Drip Edge Flashing: stainless steel
- C. Laminated Copper Composite Flashing (Type C):
1. 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:
 - a. Modified asphalt compound coated.
 - b. Asphalt saturated, Kraft paper
 - c. Asphalt saturated, waterproof glass fiber laminated fabric.
 - d. Non-asphaltic glass fabric scrim
 2. Mastic: manufacturer recommended asphalt troweled mastic for sealing copper laminated flashings
- D. Metal-clad Self-Adhering Flashing (Type D):

1. Self-Adhered Flexible Flashing: 45-mil, rubberized asphalt adhesive reinforced flashing with a high density cross laminated polyethylene film and an aluminum facing.
2. Primer: manufacturer's compatible primer from same manufacturer as membrane.

E. Miscellaneous Materials:

1. Termination Bar: 1/8 inch thick by 1 inch minimum wide stainless steel, pre-punched holes at 12 inch centers maximum, with self-tapping screws.
2. Reglets: manufacturer recommended 26 gauge galvanized, 16 ounce copper or stainless steel, as required for compatibility of flashing product.
3. Flashing Tape: Compatible tape by same manufacturer as flashing.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Adjacent Work: Protect work by masking, covering, or other precautionary methods. Remove protection when no longer necessary. Separate copper flashing from dissimilar materials.
- B. Protect membrane flashing from overexposure to direct sunlight.
- C. Utilize primer on substrates as instructed by manufacturer.

3.2 APPLICATION

A. Application Guidelines:

1. Provide membrane at all joints, holes, gaps or openings to ensure a continuously sealed building envelope.
2. For flashing at masonry and cavity walls, see Section 04 20 00
3. Follow manufacturer's instructions for installation in either bed joint, friction fit in a reglet, or mechanically fastened with a termination bar according to condition, as follows:
 - a. Horizontal Surfaces: The flashing shall be cut flush with 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, then carried upward across the cavity a minimum of 6 inches. Secure in back wall with mortar joint, reglet, or termination bar.
 - b. Vertical Surfaces: Flashing shall be carried upward a minimum of 6 inches, unless noted otherwise, and 4 inches on lower horizontal surface or through wall to facilitate drainage to exterior. Secure in back wall with mortar joint, reglet, or termination bar.
 - c. Thru-Wall Flashing: Cut flush with the exterior face of the wall after being left exposed for inspection purposes. Carry flashing through the wall, turned up where possible to facilitate drainage through the weepholes, then carried upward across the cavity a minimum of 6 inches, unless noted otherwise, and secure in back wall with mortar joint, reglet, or termination bar.
 - d. Heads and Sills: Cut flush with the exterior face of the wall after being left exposed for inspection purposes. Flashing shall be carried through the wall and upward a minimum of 8 inches, unless noted otherwise. Head flashing shall be carried 8 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.

- e. 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 2 inches.
 - f. Parapet or Coping: In a single sheet, carry flashing over top of parapet and down both sides of parapet wall a minimum of 6 inches behind the finish material or across cavity to vertical surface and secure to substrate with adhesive or self-adhere.
4. Roll self-adhering membranes as instructed by manufacturer for 100 percent complete adherence.
 5. Weather barrier shall be continued behind flashing.
 6. 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 4 inches and seal joint throughout its length with adhesive.
 7. End Joints: Avoid end joints in flashing. When end joints are necessary, lap flashing minimum 6 inches and seal joint continuously with adhesive.
 8. Penetrations: Where anchors, pipes, and inserts penetrate flashing, make opening in flashing snug and seal with adhesive.
 9. Reglet Termination: Insert wedge into place and seal carefully with adhesive
 10. Termination Bar: Install flashing with termination bars in accordance with manufacturer's instructions. Seal top of termination bar with sealant compatible with weather barrier and flashing and cover with 6 inch continuous strip of flashing tape.

3.3 SCHEDULE

- A. Steel columns and beams in exterior masonry walls: Type B or C
- B. Base (sill) weep flashing at all exterior masonry cavity walls: Type C
- C. Material transitions inside exterior cavity walls: Type B
- D. Roof edge/exterior wall transitions: Type B
- E. Parapet Caps: Type B
- F. Masonry joints (control/expansion) inside exterior cavity walls: Type B
- G. Exterior door and window frame rough opening: Type D
- H. Exterior door and window head weep condition: Type B
- I. Exterior wall penetrations (i.e. pipe, conduit, ducts, etc.): Type A
- J. Sills, Pans and Shelves: Type D
- K. Wall to wall tie-ins: Type B
- L. Deck to wall intersections: Type B
- M. Other non-roof detail areas: Type B
- N. Free standing masonry wall cap flashing: Type C

END OF SECTION

SECTION 07 72 00 - ROOF ACCESSORIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Manufactured curbs, equipment rails, and pedestals.
- B. Roof Hatches

1.2 RELATED REQUIREMENTS

- A. Section 07 62 00 - Sheet Metal Flashing and Trim: Roof accessory items fabricated from sheet metal.

1.3 SUBMITTALS

- A. General Performance: Roof accessories shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.
 - 1. Design Loads: Refer to Structural Drawings.
- B. Product Data: Manufacturer's data sheets on each product to be used.
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
 - 4. Maintenance requirements.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of roof accessory indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: For roof accessories. Include plans, elevations, keyed details, and attachments to other work. Indicate dimensions, loadings, and special conditions. Distinguish between plant- and field-assembled work.
- C. Samples: For each exposed product and for each color and texture specified, prepared on Samples of size to adequately show color.
- D. Warranty: Sample of special warranty.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store products under cover and elevated above grade.

PART 2 - PRODUCTS

2.1 MANUFACTURED CURBS

- A. Manufactured Curbs, Equipment Rails, and Other Roof Mounting Assemblies:
1. AES Manufacturing Inc.: www.aescurb.com.
 2. The Pate Company: www.patecurbs.com.
 3. Roof Products & Systems (RPS) by Commercial Products Group of Hart & Cooley, Inc: www.rpscurbs.com.
 4. Custom Curb, Inc.: www.customcurb.com.
- B. Manufactured Curbs, Equipment Rails, and Other Roof Mounting Assemblies: Factory-assembled hollow sheet metal construction with fully mitered and welded corners, integral counterflashing, internal reinforcing, and top side and edges formed to shed water.
1. Sheet Metal: Hot-dip aluminum zinc alloy coated steel sheet (Galvalume) complying with ASTM A 792/A 792M; AZ55 coating designation; 18 gage, 0.048 inch thick.
 2. Roofing Cants: Provide integral sheet metal roofing cants dimensioned to begin slope at top of roofing insulation; 1:1 slope; minimum cant height 4 inches.
 3. Manufacture curb bottom and mounting flanges for installation directly on roof deck, not on insulation; match slope and configuration of roof deck.
 4. Provide the layouts and configurations shown on the drawings.
 5. Provide angles on all four sides of all openings underneath deck.
- C. Curbs Adjacent to Roof Openings: Provide curb on all sides of opening, with top of curb horizontal for equipment mounting.
1. Provide preservative treated wood nailers along top of curb.
 2. Insulate inside curbs with 1-1/2 inch thick fiberglass insulation.
 3. Height Above Finished Roof Surface: 8 inches, minimum.
 4. Height Above Roof Deck: 14 inches, minimum.
- D. Equipment Rails: Two-sided curbs in straight lengths, with top horizontal for equipment mounting.
1. Provide preservative treated wood nailers along top of rails.
 2. Height Above Finished Roof Surface: 6 inches, minimum.
 3. Height Above Roof Deck: 14 inches, minimum.
 4. Provide angles on two sides of all openings underneath deck.
- E. Pipe, Duct, and Conduit Mounting Pedestals: Vertical posts, minimum 8 inches square unless otherwise indicated.
1. Manufacturer: PHP Systems / Design, 5534 Harvey Wilson Dr, Houston, TX 77020 (713) 672-5088)
 2. Provide sliding channel welded along top edge with adjustable height steel bracket, manufactured to fit item supported.
 3. Height Above Finished Roof Surface: 6 inches, minimum.
 4. Height above roof deck: 14" minimum

2.2 ROOF HATCHES

- A. Manufacturers - Roof Hatches, meeting structural uplift requirements:
1. Bilco - model number S-50TB

- B. Roof Hatches: Factory-assembled aluminum frame and cover, complete with operating and release hardware.
 - 1. Style: Provide flat metal covers unless otherwise indicated.
 - 2. Mounting: Provide frames and curbs suitable for mounting on flat roof deck.
 - 3. Size:
 - a. For Ladder Access: Single leaf; 30 by 54 inches.
- C. Frames/Curbs: One-piece curb and frame with integral cap flashing to receive roof flashings; extended bottom flange to suit mounting.
 - 1. Material: Mill finished aluminum, 11 gage, 0.125 inch thick.
 - 2. Insulation: 1 inch rigid glass fiber, located on outside face of curb.
 - 3. Curb Height: 12 inches from finished surface of roof, minimum.
- D. 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. Gasket: Neoprene, continuous around cover perimeter.
- E. Hardware: Type 316 stainless steel, unless otherwise indicated or required by manufacturer.
 - 1. Lifting Mechanisms: Compression or torsion spring operator with shock absorbers on each side of hatch that automatically opens upon release of latch; capable of lifting covers despite 10 psf load.
 - 2. Hinges: Heavy duty pintle type.
 - 3. Hold open arm with vinyl-coated handle for manual release.
 - 4. Latch: Upon closing, engage latch automatically and reset manual release.
 - 5. Manual Release: Pull handle on interior.
 - 6. Locking: Padlock hasp on interior. Provide lock keyed to CFISD standards.
 - 7. Safety Post: "LadderUP" by Bilco.
 - 8. Hatch Rail System: "Bil-Guard" by Bilco.
 - 9. Provide door position switch at roof hatch for security control.
 - 10. Provide two 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.
 - 11. Fall Protection Safety Rail: 30"x36" Model SP 3036 manufactured by SafePro L.C. Guardrail height shall be 42" above finished roof surface. Color shall be powder coated safety yellow.

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.

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, in manner that maintains roofing weather integrity.

3.4 PROTECTION

- A. Clean installed work to like-new condition.
- B. Protect installed products until completion of project.
- C. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 07 81 00 - APPLIED FIREPROOFING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Fireproofing of interior steel.

1.2 SUBMITTALS

- A. Product Data: Provide data indicating product characteristics.
- B. Test Reports: Reports from reputable independent testing agencies for proposed products, indicating compliance with specified criteria, conducted under conditions similar to those on project, for:
 - 1. Bond Strength.
 - 2. Bond Impact.
 - 3. Dry Density.
 - 4. Fire tests using substrate materials similar those on project.
- C. Manufacturer's Installation Instructions: Indicate thicknesses required to meet fire resistive requirements, and special procedures and conditions requiring special attention.
- D. Manufacturer's Certificate: Certify that sprayed-on fireproofing products meet or exceed requirements of contract documents.
- E. Manufacturer's Field Reports: Indicate environmental conditions under which fireproofing materials were installed.

1.3 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than five years of documented experience.
- B. Applicator Qualifications: Company specializing in performing the work of this section, with minimum five years of experience.

1.4 PROJECT CONDITIONS

- A. Sequence work in conjunction with placement of ceiling hanger tabs, mechanical component hangers, and electrical components.
- B. Do not allow roof traffic during installation of roof fireproofing and drying period.

1.5 FIELD CONDITIONS

- A. Do not apply spray fireproofing when temperature of substrate material and surrounding air is below 40 degrees F or when temperature is predicted to be below said temperature for 24 hours after application.

- B. Provide ventilation in areas to receive fireproofing during application and 24 hours afterward, to dry applied material.
- C. Provide temporary enclosure to prevent spray from contaminating air.

1.6 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.
 - 1. Include coverage for fireproofing to remain free from cracking, checking, dusting, flaking, spalling, separation, and blistering.
 - 2. Reinstall or repair failures that occur within warranty period.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Concealed Interior Conditions (Low Density):
 - 1. Carboline Company, (Southwest Fireproofing Products Co., Type 5GP)
 - 2. Grace Construction Products, W.R. Grace & Co. (Monokote MK-6)
 - 3. Isolatek International, (Cafco Blaze-Shield 300 - Wet Mix)
- B. Non-concealed Interior Conditions and Indirect Weather Conditions (Medium Density):
 - 1. Carboline Company, (Southwest Fireproofing Products Co., Type 7GP)
 - 2. Grace Construction Products, W. R. Grace & Co. (Monokote Z-106)
 - 3. Isolatek International, (Cafco Blaze-Shield HP - Dry Mix)
 - 4. Isolatek International, (Cafco Blaze-Shield 400 - Wet Mix)
- C. Substitutions: Not permitted.

2.2 FIREPROOFING ASSEMBLIES

- A. Provide UL Design assemblies as indicated on the drawings.

2.3 MATERIALS

- A. Low Density Sprayed Fire-Resistive Material: Factory mixed, cementitious material blended for uniform texture with vermiculite or lightweight synthetic aggregate, and conforming to the following requirements:
 - 1. Bond Strength: ASTM E736, 150 psf when set and dry.
 - 2. Bond Impact: ASTM E760, no cracking, flaking or delamination.
 - 3. Dry Density: ASTM E605, minimum average density of 15 lb/cu ft, with minimum individual density of any test sample of 15 lb/cu ft.
 - 4. Compressive Strength: ASTM E 761, the material shall not deform more than ten (10) percent when subjected to a crushing force of 750 psf.
 - 5. Corrosivity: No evidence of corrosion, when tested in accordance with ASTM E937.
 - 6. Air Erosion Resistance: Weight loss of 0.025 g/sq ft, maximum, when tested in accordance with ASTM E859 after 24 hours.

7. Effect of Deflection: No cracking, spalling, or delamination, when tested in accordance with ASTM E759.
 8. Surface Burning Characteristics: Maximum flame spread of 0 and maximum smoke developed of 0, when tested in accordance with ASTM E84.
- B. Medium Density Sprayed Fire-Resistive Material: Factory mixed, Portland cement blended for uniform texture with mineral aggregates or mineral fibers and additives, without chlorides, approved for exterior use and conforming to the following requirements:
1. Bond Strength: ASTM E736, 425 psf when set and dry.
 2. Bond Impact: ASTM E760, no cracking, flaking or delamination.
 3. Dry Density: ASTM E605, minimum density of 22 lb/cu ft.
 4. Compressive Strength: ASTM E 761, the material shall not deform more than ten (10) percent when subjected to a crushing force of 7,300 psf.
 5. Corrosivity: No evidence of corrosion, when tested in accordance with ASTM E937.
 6. Air Erosion Resistance: Weight loss of 0.025 g/sq ft, maximum, when tested in accordance with ASTM E859 after 24 hours.
 7. Effect of Deflection: No cracking, spalling, or delamination, when tested in accordance with ASTM E759.
 8. Surface Burning Characteristics: Maximum flame spread of 0 and maximum smoke developed of 0, when tested in accordance with ASTM E84.

2.4 ACCESSORIES

- A. Primer Adhesive: Of type recommended by fireproofing manufacturer.
- B. Metal Lath: Expanded metal lath; 3.4 lb/sq ft, galvanized finish.
- C. Water: Clean, potable.

2.5 SOURCE QUALITY CONTROL

- A. Submit evidence that the fireproofing has been tested in accordance with ASTM E119 by UL or other testing agency approved by code authorities having jurisdiction. Include evidence that the fire testing was sponsored by the manufacturer and that the material tested was produced at the manufacturer's facility under the supervision of personnel by said testing agency. Letters documenting classification status are not acceptable evidence of compliance with this Section.

2.6 EXTRA PATCHING MATERIAL

- A. Installer/subcontractor to provide General Contractor with additional materials for patching of previously applied material damaged by other trades after fireproofing installer has completed work and has left site. Provide material equal to one percent of total project quantity.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces are ready to receive fireproofing.

- B. Surfaces to receive spray-applied fireproofing shall be provided free of oil, grease, paints/primers, loose mill scale, dirt or other foreign substances which may impair proper adhesion of the fireproofing to the substrate. Where necessary, cleaning or other corrections of surfaces to receive fireproofing shall be the responsibility of the supplier of the incompatible substrate.
- C. Verify that clips, hangers, supports, sleeves, and other items required to penetrate fireproofing are in place.
- D. Verify that ducts, piping, equipment, or other items that would interfere with application of fireproofing have not been installed.
- E. Verify that voids and cracks in substrate have been filled. Verify that projections have been removed where fireproofing will be exposed to view as a finish material.

3.2 PREPARATION

- A. Perform tests as recommended by fireproofing manufacturer in situations where adhesion of fireproofing to substrate is in question.
- B. Remove incompatible materials that could affect bond by scraping, brushing, scrubbing, or sandblasting.
- C. Prepare substrates to receive fireproofing in strict accordance with instructions of fireproofing manufacturer.
- D. Apply fireproofing manufacturer's recommended bonding agent on primed steel.
- E. Protect surfaces not scheduled for fireproofing and equipment from damage by overspray, fall-out, and dusting.
- F. Close off and seal duct work in areas where fireproofing is being applied.
- G. The application of spray-applied fire resistive material shall not commence until certification has been received by the General Contractor that surfaces to receive sprayed fire protection have been inspected by the applicator and are acceptable to receive sprayed fire protection.
- H. All unsuitable substrates must be identified and made known to the General Contractor and corrected prior to the application of the spray-applied fire resistive material.

3.3 APPLICATION

- A. Install metal lath over structural members as indicated or as required by UL Assembly Design Numbers.
- B. Apply primer adhesive in accordance with manufacturer's instructions.
- C. Apply fireproofing in thickness and density necessary to achieve required ratings, with uniform density and texture.

3.4 FIELD QUALITY CONTROL

- A. Inspect the installed fireproofing after application and curing for integrity, prior to its concealment. Ensure that actual thicknesses, densities, and bond strengths meet requirements for specified ratings and requirements of the Authority Having Jurisdiction.
- B. Re-inspect the installed fireproofing for integrity of fire protection, after installation of subsequent Work.
- C. The Owner will select, and pay an independent testing laboratory to randomly sample and verify the thickness and the density of the fireproofing in accordance with one (1) of the following procedures:
 - 1. ASTM E605, Standard Test Method for Thickness and Density of Sprayed Fire-Resistive Materials Applied to Structural Members.
 - 2. AWCI TM 12-A, Standard Practice for the Testing and Inspection of Field-Applied Sprayed Fire-Resistive Materials.

3.5 REPAIRING AND CLEANING

- A. All patching of and repair to sprayed fire protection, due to damage by other trades, shall be performed under this Section.
- B. After the completion of the Work in this Section, equipment shall be removed and all surfaces not to be sprayed shall be cleaned to the extent previously agreed to by applicator and General Contractor.
- C. Unprotected concrete floors shall be left in a scraped condition.
- D. Remove excess material, overspray, droppings, and debris.
- E. Remove fireproofing from materials and surfaces not required to be fireproofed.
- F. At exposed fireproofing, clean surfaces that have become soiled or stained, using manufacturer's recommended procedures.

END OF SECTION

SECTION 07 84 00 - FIRESTOPPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Firestopping and fire safing materials.
- B. Firestopping of all joints and penetrations in fire-resistance rated and smoke-resistant assemblies, whether indicated on drawings or not, and other openings indicated.

1.2 SUBMITTALS

- A. Schedule of Firestopping: List each type of penetration, fire rating of the penetrated assembly, and firestopping test or design number.
- B. Product Data: Provide data on product characteristics, performance ratings, and limitations.
- C. Shop Drawings: Manufacturer's shop drawings or standard detail sheets indicating each condition that requires a penetration or joint seal. Details must be in accordance with the proposed approved system. Include materials to be used, anchorage, methods of installation and relationship to all adjacent construction.
- D. Manufacturer's Installation Instructions: Indicate preparation and installation instructions.
- E. Manufacturer's engineering judgment identification number and drawing details when no UL system is available for an application. Engineering judgment must include both project name and contractor's name who will install firestop system as described in drawing.
- F. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- G. Certificate from authority having jurisdiction indicating approval of materials used.
- H. Manufacturers affidavit that materials used in Project contain no asbestos.
- I. Qualification statements for installing mechanics.

1.3 QUALITY ASSURANCE

- A. Fire Testing: Provide firestopping assemblies of designs that provide the scheduled fire ratings when tested in accordance with methods indicated.
 - 1. Listing in the current-year classification or certification books of UL, FM, or ITS (Warnock Hersey) will be considered as constituting an acceptable test report.
 - 2. Valid evaluation report published by ICC Evaluation Service, Inc. (ICC-ES) at www.icc-es.org will be considered as constituting an acceptable test report.
 - 3. Submission of actual test reports is required for assemblies for which none of the above substantiation exists.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years documented experience.

- C. Installer Qualifications: Company specializing in performing the work of this section and:
 - 1. Approved by Factory Mutual Research under FM Standard 4991, Approval of Firestop Contractors, or meeting any two of the following requirements:
 - a. With minimum three years documented experience installing work of this type.
 - b. Able to show at least five satisfactorily completed projects of comparable size and type.
 - c. Licensed by authority having jurisdiction.

- D. Definitions: As they appear in this Section:
 - 1. Combustible: Penetrations composed of any material which will burn or melt in a fire, including, but not limited to the following:
 - a. Nonmetallic pipes made of glass or plastic.
 - b. Metallic pipes made of lead or aluminum.
 - c. Electrical, data, communication, security, and telephone cables.
 - 2. Non-combustible: Penetrations composed of any material which will not burn or melt in a fire, including, but not limited to the following:
 - a. Metallic pipes made of steel, iron or copper.

1.4 DELEGATED DESIGN

- A. As scope and performance documents, the Drawings and Specifications do not necessarily indicate or describe all the Work required for the performance and completion of the Work. Contracts will be let on the basis of such documents with the understanding that the Contractor shall furnish and install the items required for proper completion of the Work without adjustment to price or schedule. Work shall be of sound, quality construction and the Contractor shall be solely responsible for the inclusions of adequate labor and materials to cover the proper and timely furnishing and installation of the firestopping and fire safing indicated, described, or implied.
- B. As a performance specification, the criteria for the solution of the firestopping and fire safing indicated on the Drawings or specified herein are for the sole purpose of defining the design intent and performance requirements. The details shown, if any, are intended to emphasize the acceptable performance requirements for this Project. To avoid any misunderstanding or lack of interpretation, the Contractor is hereby advised that the responsibility for all firestopping and fire safing are totally his and that designs and resolutions proposed by the Contractor through his submittals and related documentation shall be demonstrated throughout the Work and warranty period specified herein.
- C. Design proposal submissions which follow exactly the details indicated on the Drawings, will not relieve the Contractor of his responsibility for the design, furnishing, installation, or performance of the Work of this Section.
- D. In the event of a controversy over any requirements of this Section, the decision of the Architect will take precedence.

1.5 INSTALLER QUALIFICATIONS

- A. Engage an experienced Installer who is certified, licensed, or otherwise qualified by the firestopping manufacturer as having been provided the necessary training to install manufacturer's products per specified requirements. A manufacturer's willingness to sell its firestopping products to the Contractor or to an Installer engaged by the Contractor does not in itself confer qualification on the buyer.

- B. Installer Training: A manufacturer's direct representative (not distributor or agent) to be on-site during initial installation of firestop systems to train appropriate contractor personnel in proper selection and installation procedures. This will be done per manufacturer's written recommendations published in their literature and drawing details.

1.6 FIELD CONDITIONS

- A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation. Maintain minimum temperature before, during, and for 3 days after installation of materials.
- B. Provide ventilation in areas where solvent-cured materials are being installed.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS/PRODUCTS

- A. Subject to compliance with through penetration firestop systems listed in Volume II of the UL Fire Resistance Directory (XHEZ), manufacturers specified are approved for use in the Project.
 - 1. Hilti, Inc.
 - 2. Nelson Firestop Products
 - 3. Tremco Inc.
 - 4. 3M Fire Protection Products
- B. To maintain clarity of products, specifications are based on specified products manufactured by Hilti, Inc.; Tulsa, OK. Listed manufacturers providing equivalent products are acceptable for use on this project.
- C. It is recognized that the manufacturers listed may not produce all of the specified types of products, therefore, products from several manufacturers may be used throughout the project as long as consistent use of each individual product is maintained throughout the project, they meet the requirements specified herein for the intended use, and are approved for that use by authorities having jurisdiction. Products which are combined to form a UL listed assembly must be provided as tested and approved as shown in the Fire Resistance Directory.

2.2 MATERIALS

- A. General:
 - 1. Any of the following materials, either by itself or in combination with other materials may be used on the Project provided they:
 - a. Satisfy the firestopping and fire safing requirements for use in the required application on the Project.
 - b. Meet the performance and quality assurance requirements specified herein.
 - c. Are approved for use in that application by the authorities having jurisdiction.
 - 2. Materials shall comply with ASTM E814 or ASTM E119, and shall be manufactured of non-toxic, non-hazardous, asbestos free materials. Product shall bear proper independent test laboratory label/logo and shall conform to construction assembly type, penetrating item type, annular space requirements, and fire rating involved for each separate instance.

- B. Primers: Conform to firestop manufacturer's recommendations for primers required for various substrates and conditions.
- C. Back-Up (Damming) Materials: Conform to firestop manufacturer's recommendations for back-up (damming) materials. Material may be removable or permanent as recommended by manufacturer to suit application and as required by UL testing or other testing agency approved by authorities having jurisdiction.
- D. Retainers: Steel angles, clips, sheet metal, and impaling fasteners to support damming material and fire safing material and where required by UL testing or other testing agency approved by authorities having jurisdiction.
- E. Adhesives and Fasteners: Conform to firestop manufacturer's recommendations for adhesives and fasteners required for various substrates and conditions and to suit intended use. Materials must conform to those required by UL testing or other testing agency approved by authorities having jurisdiction.
- F. Firestopping Fill, Void, and Cavity Materials: Shall conform to those required by UL testing or other testing agency approved by authorities having jurisdiction, including, but not be limited to the following. Refer to list of approved manufacturers:
 - 1. Cast-in place firestop devices for use with combustible and non-combustible pipes (closed and open piping systems) and cable bundles penetrating concrete floors, the following products are acceptable:
 - a. "CP 680 Cast-In Place Firestop Device" manufactured by Hilti, Inc
 - 1) Add Aerator adaptor when used in conjunction with aerator ("sovent") system.
 - b. "CP 681 Tub Box Kit" for use with tub installations manufactured by Hilti, Inc
 - c. "CP 682 Cast-In Place Firestop Device" for use with noncombustible penetrants manufactured by Hilti, Inc
 - 2. Sealants, caulking materials, or foams for use with non-combustible items including steel pipe, copper pipe, rigid steel conduit and electrical metallic tubing (EMT), the following products are acceptable:
 - a. "FS-ONE Intumescent Firestop Sealant" manufactured by Hilti, Inc.
 - b. "CP 604 Self-leveling Firestop Sealant" manufactured by Hilti, Inc.
 - c. "CP 620 Fire Foam" manufactured by Hilti, Inc.
 - d. "CP 606 Flexible Firestop Sealant" manufactured by Hilti, Inc.
 - e. "CP 601s Elastomeric Firestop Sealant" manufactured by Hilti, Inc.
 - 3. Sealants or caulking materials for use with sheet metal ducts, the following products are acceptable:
 - a. "CP 601s Elastomeric Firestop Sealant" manufactured by Hilti, Inc.
 - b. "CP 606 Flexible Firestop Sealant" manufactured by Hilti, Inc.
 - c. "FS-ONE Intumescent Firestop Sealant" manufactured by Hilti, Inc.
 - 4. Intumescent sealants, caulking materials for use with combustible items (penetrants consumed by high heat and flame) including insulated metal pipe, PVC jacketed, flexible cable or cable bundles and plastic pipe, the following products are acceptable:
 - a. "FS-ONE Intumescent Firestop Sealant" manufactured by Hilti, Inc
 - 5. Foams, Intumescent sealants, or caulking materials for use with flexible cable or cable bundles, the following products are acceptable:
 - a. "FS-ONE Intumescent Firestop Sealant" manufactured by Hilti, Inc
 - b. "CP 620 Fire Foam" manufactured by Hilti, Inc
 - c. "CP 601s Elastomeric Firestop Sealant" manufactured by Hilti, Inc
 - d. "CP 606 Flexible Firestop Sealant" manufactured by Hilti, Inc

6. Non curing, re-penetrable, intumescent putty or foam materials for use with flexible cable or cable bundles, the following products are acceptable:
 - a. "CP 618 Firestop Putty Stick" manufactured by Hilti, Inc
 - b. "CP 658T Firestop Plug" manufactured by Hilti, Inc
 7. Wall opening protective materials for use with U.L. listed metallic and specified nonmetallic outlet boxes, the following products are acceptable:
 - a. "CP 617 Firestop Putty Pad" manufactured by Hilti, Inc.
 8. Firestop collar or wrap devices attached to assembly around combustible plastic pipe (closed and open piping systems), the following products are acceptable:
 - a. "CP 643N Firestop Collar" manufactured by Hilti, Inc
 - b. "CP 644 Firestop Collar" manufactured by Hilti, Inc
 - c. "CP 645/648 Wrap Strips" manufactured by Hilti, Inc.
 9. Materials used for large openings and complex penetrations made to accommodate cable trays and bundles, multiple steel and copper pipes, electrical busways in raceways, the following products are acceptable:
 - a. "CP 637 Firestop Mortar" manufactured by Hilti, Inc
 - b. "FS 657 FIRE BLOCK" manufactured by Hilti, Inc
 - c. "CP 620 Fire Foam" manufactured by Hilti, Inc
 - d. "CP 675T Firestop Board" manufactured by Hilti, Inc
 10. Non curing, re-penetrable materials used for large openings and complex penetrations made to accommodate cable trays and bundles, multiple steel and copper pipes, electrical busways in raceways, the following products are acceptable:
 - a. "FS 657 FIRE BLOCK" manufactured by Hilti, Inc
 - b. "CP 675T Firestop Board" manufactured by Hilti, Inc.
 11. For blank openings made in fire-rated wall or floor assemblies, where future penetration of pipes, conduits, or cables is expected, the following products are acceptable:
 - a. "FS 657 FIRE BLOCK" manufactured by Hilti, Inc
 - b. "CP 658T Firestop Plug" manufactured by Hilti, Inc
 12. Fire Related Construction Joints and Other Gaps:
 - a. "CP 601S" Elastomeric Firestop Sealant" manufactured by Hilti, Inc.
 - b. "CP 606" Flexible Firestop Sealant" manufactured by Hilti, Inc.
 - c. "CP 672" Firestop Joint Speed Spray" manufactured by Hilti, Inc.
 13. Fire Safing Materials: Comply with ASTM C 665, Type I, high-melt mineral-fiber insulation with minimum nominal density of 4.0 lbs. per cubic foot and having a maximum flame spread rating of 15 and smoke developed rating of 0. Size shall be 4 inches thick by 24 inches wide by 48 inches long, unless noted otherwise. Products containing asbestos strictly prohibited.
 - a. "Thermafiber Safing Insulation" manufactured by Thermafiber, Inc.
 - b. "Fibrex Safing Insulation" manufactured by Fibrex Insulations, Inc.
 - c. "Delta Safing Board" manufactured by Rock Wool Manufacturing Company.
 14. Jacketing (For use with fire protection board): 0.016 inch aluminum or 0.010 inch stainless steel roll jacketing as shown, or if not shown, as required where high traffic requires high durability and good appearance, and as directed by Architect.
- G. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Type required for tested assembly design.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify openings are ready to receive the work of this section.

3.2 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter that could adversely affect bond of firestopping material.
- B. Remove incompatible materials that could adversely affect bond.
- C. Install backing materials to arrest liquid material leakage.

3.3 COORDINATION

- A. Coordinate location and proper selection of cast-in-place Firestop Devices with trade responsible for the work. Ensure device is installed before placement of concrete.
- B. Responsible trades to provide adequate spacing of field run pipes to allow for installation of cast-in-place firestop devices without interferences.

3.4 INSTALLATION

- A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.
- B. Do not cover installed firestopping until inspected by authority having jurisdiction.
- C. Install labelling required by code.

3.5 FIELD QUALITY CONTROL

- A. Field inspections and tests will be performed by an independent testing agency under provisions of Section 01 40 00.
- B. Examine sealed penetration areas to ensure proper installation before concealing or enclosing areas.
- C. Keep areas of work accessible until inspection by applicable code authorities.
- D. Inspection of through-penetration firestopping shall be performed in accordance with ASTM E 2174, "Standard Practice for On-Site Inspection of Installed Fire Stops".
- E. Perform under this section patching and repairing of firestopping caused by cutting or penetrating of existing firestop systems already installed by other trades.

3.6 PROTECTION

- A. Clean adjacent surfaces of firestopping materials.

- B. Protect adjacent surfaces from damage by material installation.

END OF SECTION

SECTION 07 90 05 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Sealants and joint backing.
- B. Precompressed foam sealers.

1.2 RELATED REQUIREMENTS

- A. All sections requiring joint sealant between material and adjacent material.

1.3 SUBMITTALS

- A. Product Data: Provide data indicating sealant chemical characteristics.
- B. Site Samples: Submit two samples, 1/4 by 3 inch in size illustrating sealant colors for selection.
- C. Manufacturer's Installation Instructions: Indicate special procedures.
- D. Manufacturer's Certification: Certify that products meet or exceed the specified requirements.
- E. Certification: Manufacturer's affidavit that materials used in the Project contain no asbestos.

1.4 ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum five years documented experience.
- B. Applicator Qualifications: Company specializing in performing the work of this section with minimum five years experience.
- C. Source Limitations: unless specifically indicated, obtain each type of building sealant through one source from a single manufacturer.
- D. Pre-construction Field Adhesive Testing: Prior to installation of building sealants, field test their adhesion to joint substrates in accordance with manufacturer's instructions. Perform test in locations indicated by Architect. Perform test for each type of building sealant and each substrate as required by Architect. If required by Architect, arrange for tests to be performed with sealant manufacturer's representative present. Follow-up review by Architect and manufacturer may be required to observe sealant performance over time and may result in re-application of sealant or replacement.
- E. Cleaning: Facade sealants that have collected dirt at the time of Substantial Completion shall be cleaned over the entire facade prior to acceptance by the Owner. 11 months after final completion of the building, if the sealant joints show dirt, they shall again be cleaned over the entire façade.

1.5 PERFORMANCE REQUIREMENTS

- A. General Performance: Joint sealants shall comply with performance requirements without failure due to defective manufacture, fabrication, installation, or other defects in construction.
- B. Structural Performance: Provide joint sealants capable of withstanding the effects of the following loads and stresses within limits and under conditions indicated, based on testing according to ASTM E 330:
 - 1. Meet load requirements in accordance with IBC-2009 , ASCE 7-98, and the following structural design loads. The System will have been successfully tested for wind, blast and impact loads as integral part of entire roofing assembly.
 - a. Wind Load:
 - 1) Wind speed: 120 mph 3-second gust
 - 2) Exposure: C
 - 3) Importance Factor: 1.0

1.6 MOCK-UP

- A. Provide mock-up of sealant joints in conjunction with window and curtain wall under provisions of Section 01 40 00.
- B. Construct mock-up with specified sealant types and with other components noted.

1.7 FIELD CONDITIONS

- A. Maintain temperature and humidity recommended by the sealant manufacturer during and after installation.

1.8 COORDINATION

- A. Coordinate the work with all sections referencing this section.

1.9 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.
- C. Warranty: Include coverage for installed sealants and accessories which fail to achieve airtight seal, exhibit loss of adhesion or cohesion, or do not cure.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Silicone Sealants:
 - 1. Bostik Inc: www.bostik-us.com.
 - 2. Momentive Performance Materials, Inc (formerly GE Silicones): www.momentive.com.
 - 3. Pecora Corporation: www.pecora.com.
 - 4. BASF Construction Chemicals-Building Systems: www.chemrex.com.
 - 5. Dow Corning: www.dowcorning.com

B. Polyurethane Sealants:

1. Bostik Inc: www.bostik-us.com.
2. Pecora Corporation: www.pecora.com.
3. BASF Construction Chemicals-Building Systems: www.chemrex.com.

C. Butyl Sealants:

1. Bostik Inc: www.bostik-us.com.
2. Pecora Corporation: www.pecora.com.

D. Acrylic Emulsion Latex Sealants:

1. Pecora Corporation; Product AC-20: www.pecora.com.
2. BASF Construction Chemicals-Building Systems; Product Sonlac: www.chemrex.com.

E. Preformed Compressible Foam Sealers:

1. EMSEAL Joint Systems, Ltd: www.emseal.com.
2. Sandell Manufacturing Company, Inc: www.sandellmfg.com.
3. Dayton Superior Corporation: www.daytonsuperior.com.
4. BASF Construction Chemicals, Inc.: www.buildingsystems.basf.com

F. Preformed Silicone Profiles:

1. Dow Corning; Product 123 Silicone Seal: www.dowcorning.com
2. Pecora Corporation; Product Sil-Span: www.pecora.com

G. Substitutions: See Section 01 25 00 - Substitution Procedures.

2.2 SEALANTS

A. Type S1 - General Purpose Exterior Sealant: Polyurethane; ASTM C 920, Type M, Grade NS, Class 25, Uses M, G, and A; single component.

1. Applications: Use for:
 - a. Other exterior non-traffic bearing vertical joints for which no other sealant is indicated.

B. Type S2 - Exterior Metal Lap Joint Sealant: Butyl or polyisobutylene, nondrying, nonskinning, noncuring.

1. Product: Chem-Calk 300 manufactured by Bostik, Inc.
2. Applications: Use for:
 - a. Concealed sealant bead in sheet metal work.

C. Type S3 - General Purpose Interior Sealant: Acrylic emulsion latex; ASTM C 834, Type OP, Grade NF single component, paintable. VOC < 50 g/l

1. Color: Standard colors matching finished surfaces.
2. Applications: Use for:
 - a. Interior wall and ceiling control joints.
 - b. Joints between door and window frames and wall surfaces.
 - c. Soft joints at tile.
 - d. Other interior non-traffic bearing joints for which no other type of sealant is indicated.

- D. Type S4 - Bathtub/Tile Sealant: White silicone; ASTM C 920, Type S, Grade NS, Class 25, Uses NT; single component, mildew resistant, non-yellowing. VOC < 50 g/l
1. Product: 898 manufactured by Pecora.
 2. Applications: Use for:
 - a. Joints between plumbing fixtures and floor and wall surfaces.
 - b. Joints between kitchen and bath countertops and wall surfaces.
 - c. Use at all kitchen and residential appliances.
- E. Type S5 - Acoustical Sealant: Butyl or acrylic sealant; ASTM C 834, Grade NS, Class 12-1/2, Uses M and A; single component, solvent release curing, non-skinning. VOC < 50 g/l
1. Product: AIS-919 manufactured by Pecora.
 2. Applications: Use for concealed locations only:
 - a. Sealant bead between top stud runner and structure, and between bottom stud track and floor, and between end stud and adjacent construction.
 - b. Wherever acoustic control is required.
- F. Type S6 - Nonsag Polyurethane Sealant: ASTM C 920, Grade NS, Class 25, Uses NT, I, T, M, A, G; multi component, chemical curing, non-staining, non bleeding, capable of continuous water immersion, non-sagging type.
1. Color: Standard colors matching finished surfaces.
 2. Product: Sonolastic NP 2 manufactured by BASF Construction Chemicals, Inc.
 3. Movement Capability: Plus and minus 50 percent.
 4. Shore A Hardness Range: 25.
 5. Applications: Use for:
 - a. Vertical exterior movement joints at concrete and masonry walls.
- G. Type S7 - Self-Leveling Polyurethane Sealant: ASTM C 920, Grade P, Class 25, Uses T, M, A; single component, chemical curing, non staining, non bleeding, self-leveling type.
1. Color: Gray.
 2. Product: Sonolastic SL 1 manufactured by BASF Construction Chemicals, Inc.
 3. Movement Capability: Plus and minus 25 percent.
 4. Service Temperature Range: -40 to 180 degrees F.
 5. Shore A Hardness Range: 25 to 40.
 6. Applications: Use for:
 - a. Horizontal concrete paving joints subject to light foot traffic and light vehicle traffic.
- H. Type S8 - Silicone Sealant: ASTM C 920, Grade NS, Class 25, Uses NT, A, G, M, O; single component, neutral curing, non-sagging, non-staining, non-bleeding.
1. Color: Custom colors matching finished surfaces. At curtain wall, match curtain wall framing color.
 2. Product: No. 795 manufactured by Dow Corning Corporation.
 3. Applications: Use for:
 - a. Joints between aluminum window/curtain wall and adjacent materials
- I. Type S9 - Interior Floor Joint Sealant: Polyurethane, self-leveling; ASTM C 920, Grade P, Class 25, Uses T, M and A; single component. VOC < 50 g/l
1. Approved by manufacturer for wide joints up to 1-1/2 inches.
 2. Color: Standard colors matching finished surfaces.
 3. Product: Sonolastic NP-1 manufactured by BASF.
 4. Applications: Use for:
 - a. Expansion joints in floors.

2.3 ACCESSORIES

- A. Primer: Non-staining type, recommended by sealant manufacturer to suit application.
- B. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.
- C. Compressible Foam Joint Filler: Compatible with sealant; closed cell polyethylene; oversized 25 to 50 percent larger than joint width, surface water absorption of not more than 0.1 pounds per square foot,.
- D. 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.
- E. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that substrate surfaces and joint openings are ready to receive work.
- B. Verify that joint backing and release tapes are compatible with sealant.

3.2 PREPARATION

- A. Remove loose materials and foreign matter that could impair adhesion of sealant.
- B. Clean and prime joints in accordance with manufacturer's instructions.
- C. Perform preparation in accordance with manufacturer's instructions and ASTM C 1193.
- D. Protect elements surrounding the work of this section from damage or disfigurement.

3.3 INSTALLATION

- A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
- B. Perform installation in accordance with ASTM C 1193.
- C. Perform acoustical sealant application work in accordance with ASTM C 919.
- D. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer, except where specific dimensions are indicated.
- E. Measure joint dimensions and size joint backers to achieve the following, unless otherwise indicated:

1. Width/depth ratio of 2:1.
 2. Neck dimension no greater than 1/3 of the joint width.
 3. Surface bond area on each side not less than 75 percent of joint width.
- F. Install bond breaker where joint backing is not used.
- G. Install sealant free of air pockets, foreign embedded matter, ridges, and sags.
- H. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
- I. Tool joints concave.
- J. Precompressed Foam Sealant: Do not stretch; avoid joints except at corners, ends, and intersections; install with face 1/8 to 1/4 inch below adjoining surface.
- K. Compression Gaskets: Avoid joints except at ends, corners, and intersections; seal all joints with adhesive; install with face 1/8 to 1/4 inch below adjoining surface.

3.4 FIELD QUALITY CONTROL

- A. Field-Adhesion Testing: Engage an independent testing agency to field test joint-sealant adhesion to joint substrates as follows:
1. Extent of Testing: Test completed and cured sealant joints as follows:
 - a. Perform 10 tests for the first 1000 feet of joint length for each kind of sealant and joint substrate. Minimum 3 tests per sealant and joint substrate.
 - b. Perform 1 test for each 1000 feet of joint length thereafter or 1 test per each floor per elevation.
 - c. Perform tests again 60 days after original sealant installation.
 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.
 - a. 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's 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 that original sealant surfaces are clean and that new sealant contacts original sealant.

- B. Evaluation of Field-Adhesion Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other 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 CLEANING

- A. Clean adjacent soiled surfaces.

3.6 PROTECTION

- A. Protect sealants until cured.

END OF SECTION

SECTION 07 95 00 - EXPANSION CONTROL

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Interior expansion control systems.
 - 2. Exterior wall expansion control systems.
- B. Related Requirements:
 - 1. Section 07 92 00 "Joint Sealants" for liquid-applied joint sealants and for elastomeric sealants without metal frames.

1.2 ACTION SUBMITTALS

- A. Shop Drawings: For each expansion control system specified. Include plans, elevations, sections, details, splices, blockout requirement, attachments to other work, and line diagrams showing entire route of each expansion control system. Where expansion control systems change planes, provide isometric or clearly detailed drawing depicting how components interconnect.
- B. Samples: For each exposed expansion control system and for each color and texture specified, full width by 6 inches long in size.
- C. Product Schedule: Prepared by or under the supervision of the supplier. Include the following information in tabular form:
 - 1. Manufacturer and model number for each expansion control system.
 - 2. Expansion control system location cross-referenced to Drawings.
 - 3. Nominal joint width.
 - 4. Movement capability.
 - 5. Classification as thermal or seismic.
 - 6. Materials, colors, and finishes.
 - 7. Product options.
 - 8. Fire-resistance ratings.

1.3 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each fire barrier provided as part of an expansion control system, for tests performed by a qualified testing agency.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. General: Provide expansion control systems of design, basic profile, materials, and operation indicated. Provide units with capability to accommodate variations in adjacent surfaces.

1. Furnish units in longest practicable lengths to minimize field splicing. Install with hairline mitered corners where expansion control systems change direction or abut other materials.
 2. Include factory-fabricated closure materials and transition pieces, T-joints, corners, curbs, cross-connections, and other accessories as required to provide continuous expansion control systems.
- B. Coordination: Coordinate installation of exterior wall[**and soffit**] expansion control systems with roof expansion control systems to ensure that wall transitions are watertight. Roof expansion joint assemblies are specified elsewhere.

2.2 INTERIOR EXPANSION CONTROL SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, [provide products by the following] [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 or a comparable product by one of the following:
1. Architectural Art Mfg., Inc.; Division of Pittcon Industries.
 2. Balco, Inc.
 3. Construction Specialties, Inc.
 4. JointMaster/InPro Corporation.
 5. MM Systems Corporation.
 6. Nystrom, Inc.
 7. Watson Bowman Acme Corp.; a BASF Construction Chemicals business.
- C. Source Limitations: Obtain expansion control systems from single source from single manufacturer.
- D. Wall-to-Wall <EJ-1>:
1. Basis-of-Design Product: Balco No. 75FWG-2.
 2. Design Criteria:
 - a. Nominal Joint Width: 2-inches
 - b. Movement Capability: -25 percent/+25 percent.
 - c. Type of Movement: Thermal.
 - d. Fire-Resistance Rating: Where required, provide expansion control system and fire-barrier assembly with a rating not less than that of adjacent construction.
 3. Type: Elastomeric seal with metal base.
 - a. Metal: Aluminum.
 - 1) Finish: Mill.
 - b. Seal Material: Manufacturer's standard.
 - 1) Color: As selected by Architect from manufacturer's full range.
- E. Ceiling-to-Ceiling <EJ-2>:
1. Basis-of-Design Product: Balco No. 75FCA-2.
 2. Design Criteria:
 - a. Nominal Joint Width: 2-inches
 - b. Movement Capability: -25 percent/+25 percent.
 - c. Type of Movement: Thermal.
 - d. Fire-Resistance Rating: Where required, provide expansion control system and fire-barrier assembly with a rating not less than that of adjacent construction.

3. Type: Elastomeric seal with metal base.
 - a. Metal: Aluminum.
 - 1) Finish: Mill.
 - b. Seal Material: Manufacturer's standard.
 - 1) Color: As selected by Architect from manufacturer's full range.

2.3 EXTERIOR WALL EXPANSION CONTROL SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, [provide products by the following] [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 or a comparable product by one of the following:
 1. Architectural Art Mfg., Inc.; Division of Pittcon Industries.
 2. Balco, Inc.
 3. Construction Specialties, Inc.
 4. EMSEAL Corporation.
 5. JointMaster/InPro Corporation.
 6. MM Systems Corporation.
 7. Nystrom, Inc.
 8. Tremco Incorporated.
 9. Watson Bowman Acme Corp.; a BASF Construction Chemicals business.
- C. Source Limitations: Obtain expansion control systems from single source from single manufacturer.
- D. Wall-to-Wall (Brick-to-Brick) <EJ-3>:
 1. Basis-of-Design Product: EMSEAL Color-seal.
 2. Design Criteria:
 - a. Nominal Joint Width: 2-inches.
 - b. Type of Movement: Thermal.
 - c. Fire-Resistance Rating: Where required, provide expansion control system and fire-barrier assembly with a rating not less than that of adjacent construction.
 3. Type: Preformed cellular foam.
 - a. Foam Material: Manufacturer's standard.
 - 1) Color: As selected by Architect from manufacturer's full range.

2.4 ACCESSORIES

- A. Moisture Barriers: Manufacturer's standard moisture barrier consisting of a continuous, waterproof membrane within joint and attached to substrate on sides of joint below the primary cover.
 1. Drain-Tube Assemblies: Equip moisture barrier with drain tubes and seals to direct collected moisture to drain.

2.5 MATERIALS

- A. Aluminum: ASTM B 221, Alloy 6063-T5 for extrusions; ASTM B 209, Alloy 6061-T6 for sheet and plate.

1. Apply manufacturer's standard protective coating on aluminum surfaces to be placed in contact with cementitious materials.
- B. Elastomeric Seals: ASTM E 1783; preformed elastomeric membranes or extrusions to be installed in metal frames.
- C. Compression Seals: ASTM E 1612; preformed elastomeric extrusions having an internal baffle system and designed to function under compression.
- D. Cellular Foam Seals: Extruded, compressible foam designed to function under compression.
- E. Elastomeric Concrete: Modified epoxy or polyurethane extended into a prepackaged aggregate blend, specifically designed for bonding to concrete substrates.
- F. Fire Barriers: Any material or material combination, when fire tested after cycling, designated to resist the passage of flame and hot gases through a movement joint and to meet performance criteria for required fire-resistance rating.
- G. Moisture Barrier: Flexible elastomeric material, [PVC, minimum 30 mils thick] [EPDM, minimum 45 mils thick] [Santoprene].
- H. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107/C 1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.
- I. Accessories: Manufacturer's standard anchors, clips, fasteners, set screws, spacers, and other accessories compatible with material in contact, as indicated or required for complete installations.

2.6 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "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. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.7 ALUMINUM FINISHES

- A. Mill finish.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces where expansion control systems will be installed for installation tolerances and other conditions affecting performance of work.
 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare substrates according to expansion control system manufacturer's written instructions.
- B. Coordinate and furnish anchorages, setting drawings, and instructions for installing expansion control systems. Provide fasteners of metal, type, and size to suit type of construction indicated and to provide for secure attachment of expansion control systems.
- C. Cast-In Frames: Coordinate and furnish frames to be cast into concrete.

3.3 INSTALLATION

- A. Comply with manufacturer's written instructions for storing, handling, and installing expansion control systems and materials unless more stringent requirements are indicated.
- B. Metal Frames: Perform cutting, drilling, and fitting required to install expansion control systems.
 - 1. Install in true alignment and proper relationship to joints and adjoining finished surfaces measured from established lines and levels.
 - 2. Adjust for differences between actual structural gap and nominal design gap due to ambient temperature at time of installation. Notify Architect where discrepancies occur that will affect proper expansion control system installation and performance.
 - 3. Cut and fit ends to accommodate thermal expansion and contraction of metal without buckling of frames.
 - 4. Repair or grout blockout as required for continuous frame support using nonmetallic, shrinkage-resistant grout.
 - 5. Install frames in continuous contact with adjacent surfaces.
 - a. Shimming is not permitted.
 - 6. Locate anchors at interval recommended by manufacturer, but not less than 3 inches from each end and not more than 24 inches o.c.
- C. Seals in Metal Frames: Install elastomeric seals and membranes in frames to comply with manufacturer's written instructions. Install with minimum number of end joints.
 - 1. Provide in continuous lengths for straight sections.
 - 2. Seal transitions according to manufacturer's written instructions. Vulcanize or heat-weld field-spliced joints as recommended by manufacturer.
 - 3. Installation: Mechanically lock seals into frames or adhere to frames with adhesive or pressure-sensitive tape as recommended by manufacturer.
- D. Foam Seals: Install with adhesive recommended by manufacturer.
- E. Terminate exposed ends of expansion control systems with field- or factory-fabricated termination devices.
- F. Fire-Resistance-Rated Assemblies: Coordinate installation of expansion control system materials and associated work so complete assemblies comply with assembly performance requirements.
 - 1. Fire Barriers: Install fire barriers to provide continuous, uninterrupted fire resistance throughout length of joint, including transitions and field splices.
- G. Moisture Barrier: Provide at all exterior joints and where indicated on Drawings. Provide drainage fittings at a maximum of 50 feet or where indicated on Drawings.

3.4 PROTECTION

- A. Do not remove protective covering until finish work in adjacent areas is complete. When protective covering is removed, clean exposed metal surfaces to comply with manufacturer's written instructions.
- B. Protect the installation from damage by work of other Sections. Where necessary due to heavy construction traffic, remove and properly store cover plates or seals and install temporary protection over expansion control systems. Reinstall cover plates or seals prior to Substantial Completion of the Work.

END OF SECTION

SECTION 08 11 13 - STEEL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Steel doors.
 - 2. Steel door frames.
 - 3. Steel window frames
 - 4. Sidelight frames
 - 5. Borrowed-light frames.
 - 6. Fire-rated door and frame assemblies.

1.2 PERFORMANCE REQUIREMENTS

- A. General Performance: Steel door and frame assemblies shall comply with performance requirements without failure due to defective manufacture, fabrication, installation, or other defects in construction.
- B. Delegated Design: Design steel doors and frames, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated. Refer to Section 01 33 00 for information regarding delegated design submittals.
- C. See Field Quality Control for testing of assembly.
- D. Exterior Door and Frame Structural Performance: Provide metal plate wall panel assemblies capable of withstanding the effects of the following loads and stresses within limits and under conditions indicated, based on testing according to ASTM E 330:
 - 1. Meet load requirements in accordance with IBC-2012 , ASCE 7-05, and the following structural design loads. The System will have been successfully tested for wind, blast and impact loads.
 - a. Wind Load:
 - 1) Wind speed: 110 mph 3-second gust
 - 2) Exposure: C
 - 3) Importance Factor: 1.0
 - 2. Deflection Limits: Metal plate wall panel assemblies shall withstand wind loads with horizontal deflections no greater than 1/240 of the span.
- E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

1.3 SUBMITTALS

- A. Product Data for each type of door and frame specified, including details of construction, materials, dimensions, hardware preparation, core, label compliance, sound ratings, profiles, and finishes.
- B. Shop Drawings showing fabrication and installation of steel doors and frames. Include details of each frame type, elevations of door design types, conditions at openings, details of construction, location and installation requirements of door and frame hardware, security devices, and reinforcements, and details of joints and connections. Show anchorage and accessory items.
- C. Door Schedule: Submit schedule of doors and frames using same reference numbers for details and openings as those on Contract Drawings.
 - 1. Indicate coordination of glazing frames and stops with glass and glazing requirements.
- D. 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.

1.4 QUALITY ASSURANCE

- A. Provide doors and frames complying with ANSI/SDI 100 "Recommended Specifications for Standard Steel Doors and Frames" and as specified.
- B. Fire-Rated Door Assemblies: Units that comply with NFPA 80, are identical to door and frame assemblies tested for fire-test-response characteristics per ASTM E 152, and are labeled and listed by UL, Warnock Hersey, or another testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1. Temperature-Rise Rating: Where indicated, provide doors that have a temperature-rise rating of 450 deg F maximum in 30 minutes of fire exposure.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver doors and frames cardboard-wrapped or crated to provide protection during transit and job storage. Provide additional protection to prevent damage to finish of factory-finished doors and frames.
- B. Inspect doors and frames on delivery for damage. Minor damages may be repaired provided refinished items match new work and are acceptable to Architect; otherwise, remove and replace damaged items as directed.
- C. Store doors and frames at building site under cover. Place units on minimum 4-inch- high wood blocking. Avoid using nonvented plastic or canvas shelters that could create a humidity chamber. If cardboard wrappers on doors become wet, remove cartons immediately. Provide minimum 1/4-inch spaces between stacked doors to promote air circulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Steel Doors and Frames:
 - a. Amweld Building Products, Inc.
 - b. Benchmark Commercial Doors; a division of General Products Co., Inc.
 - c. Ceco Door Products; a United Dominion Company.
 - d. Copco Door Co.
 - e. Curries Company.
 - f. Deansteel Manufacturing, Inc.
 - g. Kewanee Corporation (The).
 - h. Mesker Door, Inc.
 - i. Pioneer Industries Inc.
 - j. Republic Builders Products.
 - k. Steelcraft; a division of Ingersoll-Rand
 - l. Door Pro Systems

2.2 DOORS AND FRAMES

- A. Requirements for All Doors and Frames:
1. Accessibility: Comply with ANSI/ICC A117.1.
 2. Door Top Closures: Flush with top of faces and edges.
 3. Door Edge Profile: Beveled on both edges.
 4. Door Texture: Smooth faces.
 5. Glazed Lights: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings.
 6. Hardware Preparation: In accordance with BHMA A156.115, with reinforcement welded in place, in addition to other requirements specified in door grade standard.
 7. Finish: Factory primed, for field finishing.
- B. Galvanizing for Exterior Units and Units in Wet Areas: All components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A 653/A 653M, A60/ZF180.
- C. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with all the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

2.3 MATERIALS

- A. Hot-Rolled Steel Sheets and Strip: Commercial-quality carbon steel, pickled and oiled, complying with ASTM A 569.
- B. Cold-Rolled Steel Sheets: Carbon steel complying with ASTM A 366, commercial quality, or ASTM A 620, drawing quality, special killed.

- C. Galvanized Steel Sheets: Zinc-coated carbon steel complying with ASTM A 653, commercial quality, or ASTM A 642, drawing quality, hot-dip galvanized according to ASTM A 653, with A 60 or G 60 coating designation, mill phosphatized.
- D. Supports and Anchors: Fabricated from not less than 0.0478-inch- thick steel sheet; 0.0516-inch-thick galvanized steel where used with galvanized steel frames.
- E. Inserts, Bolts, and Fasteners: Manufacturer's standard units. Where items are to be built into exterior walls, hot-dip galvanize complying with ASTM A 153, Class C or D as applicable.
- F. Shop Applied Paint: Apply after fabrication.
 - 1. Primer: Rust-inhibitive enamel or paint, either air-drying or baking, suitable as a base for specified finish paints complying with ANSI A224.1, "Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames

2.4 DOORS

- A. Steel Doors: Provide 1-3/4-inch- thick doors of materials and ANSI/SDI 100 grades and models specified below, or as indicated on Drawings or schedules:
 - 1. Interior Doors: Grade III, extra heavy-duty, Model 2, seamless design, minimum 0.0635-inch- thick (16 ga.) cold-rolled steel sheet faces.
 - 2. Exterior Doors: Grade III, extra heavy-duty, Model 2, seamless design, minimum 0.0635-inch- thick (16 ga.) galvanized steel sheet faces.

2.5 FRAMES

- A. Provide metal frames for doors, windows, transoms, sidelights, borrowed lights, interior windows, and other openings, according to ANSI/SDI 100, and of types and styles as shown on Drawings and schedules. Conceal fastenings, unless otherwise indicated.
 - 1. Fabricate frames with mitered or coped and continuously welded corners.
 - 2. Interior Frames: Grade II, heavy-duty, Model 2, seamless design, minimum 0.0635-inch-thick (16 ga.) cold-rolled steel.
 - 3. Exterior Frames: Grade III, extra heavy-duty, Model 2, seamless design, minimum 0.0747-inch- thick (14 ga.) galvanized steel.
 - 4. All frames to be provided with temporary spreader bar.
 - 5. All frames to conceal electrical wires as needed for the security hardware / devices.
- B. Door Silencers: Except on weatherstripped frames, drill stops to receive 3 silencers on strike jambs of single-door frames and 2 silencers on heads of double-door frames.

2.6 ACCESSORY MATERIALS

- A. Grout for Frames: Portland cement grout of maximum 4-inch slump for hand troweling in accordance with Section 04 20 00; thinner pumpable grout is prohibited.
- B. Temporary Frame Spreaders: Provide for all factory- or shop-assembled frames.

2.7 OPENINGS (GLASS VISION PANEL)

- A. Provide continuous perimeter reinforcement.

- B. At vision panels, provide 1/8 inch glazing tolerance in addition to glass thickness.
- C. Glazing Stops: Minimum 0.0359-inch- thick steel square profile.
 - 1. Provide nonremovable stops on outside of exterior doors and on secure side of interior doors for glass, louvers, and other panels in doors; mitered and welded in place.
 - 2. Provide screw-applied, removable, glazing beads on inside of glass, louvers, and other panels in doors. Provide flush Philips or Jackson head fasteners exposed to view. Provide loose stops other side, mitered, drilled and tapped for OHCS Phillips head machine screws maximum 12 inches on center.
- D. Door Louver
 - 1. Manufacturer's standard inverted "V" blade
 - 2. Perimeter frame/trim, mounting hardware, and accessories for a complete assembly

2.8 FABRICATION

- A. Fabricate steel door and frame units to be rigid, neat in appearance, and free from defects, warp, or buckle. Where practical, fit and assemble units in manufacturer's plant. Clearly identify work that cannot be permanently factory assembled before shipment, to assure proper assembly at Project site. Comply with ANSI/SDI 100 requirements.
 - 1. Steel Stiffened Core: All doors to have minimum 20-gauge steel (galvanized steel at exterior) stiffeners maximum 6-inches on center vertically and permanently attached to both door faces.
 - 2. Internal Core In-fill Construction: One of the following manufacturer's standard core materials according to SDI standards:
 - a. Rigid polystyrene conforming to ASTM C 578. Modify infill as needed for fire rated doors.
 - 1) Clearances: Not more than 1/8 inch at jambs and heads, except not more than 1/4 inch between non-fire-rated pairs of doors. Not more than 3/4 inch at bottom.
 - a) Fire Doors: Provide clearances according to NFPA 80.
- B. Fabricate exposed faces of doors and panels, including stiles and rails of nonflush units, from only cold-rolled steel sheet.
- C. Tolerances: Comply with SDI 117 "Manufacturing Tolerances Standard Steel Doors and Frames."
- D. Fabricate concealed stiffeners, reinforcement, edge channels, and moldings from either cold- or hot-rolled steel sheet.
- E. Galvanized Steel Doors, Panels, and Frames: For the following locations, fabricate doors, panels, and frames from galvanized steel sheet according to SDI 112. Close top and bottom edges of doors flush as an integral part of door construction or by addition of minimum 0.0635-inch- thick galvanized steel channels, with channel webs placed even with top and bottom edges. Seal joints in top edges of doors against water penetration.
 - 1. At exterior locations and interior non-air conditioned spaces in the warehouse and equipment centers.
 - 2. Provide galvanizing at all sealant area rooms
- F. Exposed Fasteners: Unless otherwise indicated, provide countersunk flat or oval heads for exposed screws and bolts.

- G. Thermal-Rated (Insulating) Assemblies: Provide at exterior locations. Provide elsewhere as shown or scheduled. Provide doors fabricated as thermal-insulating door and frame assemblies and tested according to ASTM C 236 or ASTM C 976 on fully operable door assemblies.
 - 1. Unless otherwise indicated, provide thermal-rated assemblies with U-value rating of 0.41 Btu/sq. ft. x h x deg F or better.
- H. Sound-Rated (Acoustical) Assemblies: Provide door and frame assemblies fabricated as sound-reducing type, tested according to ASTM E 1408, and classified according to ASTM E 413.
 - 1. Unless otherwise indicated, provide acoustical assemblies with STC sound ratings of 33 or better.
- I. Hardware and Security Device Preparation: Prepare doors and frames to receive mortised and concealed hardware according to final door hardware schedule, Owner supplied Security Devices, and templates provided by hardware supplier and Owner security supplier. Comply with applicable requirements of SDI 107 and ANSI A115 Series specifications for door and frame preparation for hardware.
 - 1. For concealed overhead door closers, provide space, cutouts, reinforcing, and provisions for fastening in top rail of doors or head of frames, as applicable.
- J. Reinforce doors and frames to receive surface-applied hardware and security devices. Drilling and tapping for surface-applied hardware may be done at Project site.
- K. Locate hardware as indicated on Shop Drawings or, if not indicated, according to the Door and Hardware Institute's (DHI) "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."

2.9 FINISHES, GENERAL

- A. Comply with SSPC-PA 1, "Paint Application Specification No. 1," for steel sheet finishes.
- B. Apply primers and organic finishes to doors and frames after fabrication.
- C. Final finish painting will be per specification Section 09 90 00 - Painting.

2.10 GALVANIZED STEEL SHEET FINISHES

- A. Surface Preparation: Clean surfaces with nonpetroleum solvent so that surfaces are free of oil or other contaminants. After cleaning, apply a conversion coating of the type suited to the organic coating applied over it. Clean welds, mechanical connections, and abraded areas, and apply galvanizing repair paint specified below to comply with ASTM A 780.
 - 1. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in galvanized steel, with dry film containing not less than 94 percent zinc dust by weight, and complying with DOD-P-21035 or SSPC-Paint 20.
- B. Factory Priming for Field-Painted Finish: Where field painting after installation is indicated, apply air-dried primer specified below immediately after cleaning and pretreatment.
 - 1. Shop Primer: Zinc-dust, zinc-oxide primer paint complying with performance requirements of FS TT-P-641, Type II.
 - 2. Coat interior and concealed surfaces of all frames scheduled to be grouted or in contact with masonry / concrete with Bituminous coating

2.11 STEEL SHEET FINISHES

- A. Surface Preparation: Solvent-clean surfaces to comply with SSPC-SP 1 to remove dirt, oil, grease, and other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel to comply with SSPC-SP 5 (White Metal Blast Cleaning) or SSPC-SP 8 (Pickling).
- B. Pretreatment: Immediately after surface preparation, apply a conversion coating of type suited to organic coating applied over it.
- C. Factory Priming for Field-Painted Finish: Apply shop primer that complies with ANSI A224.1 acceptance criteria, is compatible with finish paint systems indicated, and has capability to provide a sound foundation for field-applied topcoats. Apply primer immediately after surface preparation and pretreatment.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install steel doors, frames, and accessories according to Shop Drawings, manufacturer's data, and as specified.
- B. Placing Frames: Comply with provisions of SDI 105, unless otherwise indicated. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is completed, remove temporary braces and spreaders, leaving surfaces smooth and undamaged.
 - 1. Except for frames located in existing concrete, masonry, or gypsum board assembly construction, place frames before constructing enclosing walls and ceilings.
 - 2. In masonry construction, install at least 3 wall anchors per jamb adjacent to hinge location on hinge jamb and at corresponding heights on strike jamb. Acceptable anchors include masonry wire anchors and masonry T-shaped anchors.
 - 3. At existing concrete or masonry construction, install at least 3 completed opening anchors per jamb adjacent to hinge location on hinge jamb and at corresponding heights on strike jamb. Set frames and secure to adjacent construction with bolts and masonry anchorage devices.
 - 4. In metal-stud partitions, install at least 3 wall anchors per jamb at hinge and strike levels. In steel-stud partitions, attach wall anchors to studs with screws.
 - 5. Install fire-rated frames according to NFPA 80.
- C. Door Installation: Fit hollow-metal doors accurately in frames, within clearances specified in ANSI/SDI 100.
 - 1. Fire-Rated Doors: Install with clearances specified in NFPA 80.
 - 2. Smoke-Control Doors: Comply with NFPA 105.
 - 3. Install in accordance with the requirements of the specified door grade standard and NAAMM HMMA 840.

3.2 ADJUSTING AND CLEANING

- A. Prime Coat Touchup: Immediately after erection, sand smooth any rusted or damaged areas of prime coat and apply touchup of compatible air-drying primer.

- B. Protection Removal: Immediately before final inspection, remove protective wrappings from doors and frames.
- C. Provide bituminous coating on the interior of all frames that come in contact with masonry, tile and/or grout.
- D. Adjust door for smooth and balanced door movement.

3.3 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for independent testing and inspection requirements.
- B. Engage an independent testing agency and test 100 percent of installed exterior door and frame assemblies for air leakage in accordance with ASTM E 283. Maximum air leakage shall be 0.03 CFM/SF.

3.4 TOLERANCES

- A. Clearances Between Door and Frame: As specified in ANSI A250.8.
- B. Maximum Diagonal Distortion: 1/16 in measured with straight edge, corner to corner.

END OF SECTION

SECTION 08 11 16 - INTERIOR ALUMINUM FRAMES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Interior aluminum door and window frames.
- B. Accessories, including louvers, fasteners, and brackets.

1.2 RELATED REQUIREMENTS

- A. Section 08 14 16 - Flush Wood Doors.
- B. Section 08 71 00 - Door Hardware.
- C. Section 08 80 00 - Glazing.

1.3 SUBMITTALS

- A. Product Data: Manufacturer's descriptive literature for each type of door; include information on fabrication methods.
- B. Shop Drawings: Include elevations of each opening type.
 - 1. Verify dimensions by field measurements before fabrication and indicate on shop drawings.
- C. Verification Samples: Actual pieces of products in each finish specified, not less than 6 inches square or 6 inches long for linear components. For finishes subject to color variation, include not less than two samples illustrating extreme range to be anticipated.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Not less than 5 years of experience in manufacturing components of the types specified.
- B. Installer Qualifications: Firm with documented experience in installing components of the types specified.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver aluminum components in manufacturer's standard protective packaging, palletted, crated, or banded together.
- B. Inspect delivered components for damage and replace. Repaired components will not be accepted.
- C. Store components under cover in manufacturer's packaging until installation.

1.6 FIELD CONDITIONS

- A. Do not begin installation of interior aluminum components until space has been enclosed and ambient thermal conditions are being maintained at levels consistent with final project requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. The design of the project has been based on products manufactured by Raco Interior Products, Inc.; www.racointeriors.com.
 - 1. Other Acceptable Manufacturers:
 - a. Cline Aluminum Doors, Inc: www.clinedoors.com
 - b. Frameworks; www.frameworks.com
 - c. Wilson Partitions: www.wilsonpart.com
 - 2. Substitutions: See Section 01 25 00 - Substitution Procedures.

2.2 MATERIALS

- A. Aluminum Sheet: ASTM B 209, alloy 5005-H14, stretcher leveled. Determine aluminum thickness to support doors and glazing with the dimensions indicated.
- B. Extruded Aluminum: ASTM B 221, alloy 6063-T5 or alloy 6463-T5.

2.3 COMPONENTS

- A. Aluminum Door and window frames: Provide frames sized to fit wall thicknesses indicated on the drawings, in profiles indicated, and constructed from materials as follows:
 - 1. Frame Members: Extruded aluminum shapes, not less than 0.062 in thick, reinforced at closer, hinge and strike locations. Size thickness to account for doors and glazing supported.
 - 2. Corner Brackets: Extruded aluminum, fastened with stainless steel screws.
 - 3. Trim: Extruded aluminum, not less than 0.062 in thick, removable snap-in type without exposed fasteners.
 - 4. Replaceable Weatherstripping: AAMA 701/702 wool pile.
 - 5. Glazing: As specified in Section 08 80 00 - Glazing.
 - 6. Finished end frames: Extruded aluminum shapes, not less than 0.062 in thick, profile size and finish to match door and window framing members. One piece frame to extend from floor to ceiling.

2.4 FINISHES

- A. Finish: High Performance Organic Coating: Kynar/Polyvinylidene Fluoride (PVDF) complying with requirements of AAMA 2604; color as selected from manufacturer's full range by Architect.

2.5 FABRICATION

- A. Aluminum frames: Sizes and contours as indicated on drawings.

2.6 ACCESSORIES

- A. Fasteners: Aluminum, non-magnetic stainless steel, or other material warranted by manufacturer as non-corrosive and compatible with aluminum components.
- B. Brackets and Reinforcements: Manufacturer's high-strength aluminum units where feasible, otherwise, non-magnetic stainless steel or steel hot-dip galvanized in compliance with ASTM A 123/A 123M.
- C. Bituminous Coating: Cold-applied asphaltic mastic, compounded for 30-mil thickness per coat.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that wall surfaces and openings are ready to receive frames and are within tolerances specified in manufacturer's instructions.
- B. Verify that frames installed by other trades for installation of doors of this section are in strict accordance with recommendations and approved shop drawings and within tolerances specified in manufacturer's instructions.

3.2 PREPARATION

- A. Perform cutting, fitting, forming, drilling, and grinding of frames as required for project conditions.
- B. Replace components with damage to exposed finishes.
- C. Separate dissimilar metals to prevent electrolytic action between metals.

3.3 INSTALLATION

- A. Install frames in accordance with manufacturer's instructions and approved shop drawings.
- B. Set frames plumb, square, level, and aligned to receive doors/windows. Anchor frames to adjacent construction in strict accordance with manufacturer's recommendations and within specified tolerances.
- C. Where aluminum surfaces contact metals other than stainless steel, zinc, or small areas of white bronze, protect from direct contact by painting dissimilar metal with heavy coating of bituminous paint.
- D. Install glass in frames as specified in Section 08 80 00.

3.4 CLEANING

- A. Upon completion of installation, thoroughly clean door and frame surfaces in accordance with AAMA 609.
- B. Do not use abrasive, caustic, or acid cleaning agents.

3.5 PROTECTION

- A. Protect products of this section from damage caused by subsequent construction until substantial completion.
- B. Replace damaged or defective components that cannot be repaired to a condition indistinguishable from undamaged components.

END OF SECTION

SECTION 08 14 16 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Solid-core doors with plastic laminate faces.
- B. Related Requirements:
 - 1. Section 08 80 00 "Glazing" for glass view panels in flush wood doors.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of door. Include details of core and edge construction and trim for openings. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; and the following:
 - 1. Dimensions and locations of blocking.
 - 2. Dimensions and locations of mortises and holes for hardware.
 - 3. Dimensions and locations of cutouts.
 - 4. Undercuts.
 - 5. Fire-protection ratings for fire-rated doors.
- B. Samples for Verification:
 - 1. Corner sections of doors, approximately 8 by 10 inches, with door faces and edges representing actual materials to be used.
 - a. Plastic laminate, 6 inches square, for each color, texture, and pattern selected.
 - 2. Frames for light openings, 6 inches long, for each material, type, and finish required.

1.4 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For special warranty.
- B. Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements of referenced standard and manufacturer's written instructions.
- B. Package doors individually in plastic bags or cardboard cartons.
- C. Mark each door on top and bottom rail with opening number used on Shop Drawings.

1.6 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during remainder of construction period.

1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
 - a. Warping (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section.
 - b. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.
 2. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
 3. Warranty Period for Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or comparable:
1. Graham Wood Doors; an Assa Abloy Group company.
 2. Masonite Architectural.
 3. VT Industries, Inc.
- B. Source Limitations: Obtain flush wood doors from single manufacturer.

2.2 FLUSH WOOD DOORS, GENERAL

- A. Quality Standard: In addition to requirements specified, comply with AWI's, AWMAC's, and WI's "Architectural Woodwork Standards."
1. Contract Documents contain selections chosen from options in quality standard and additional requirements beyond those of quality standard. Comply with those selections and requirements in addition to quality standard.
- B. WDMA I.S.1-A Performance Grade:
1. Heavy Duty unless otherwise indicated.
 2. Extra Heavy Duty: Public toilets, janitor's closets, assembly spaces, and exits.
 3. Standard Duty: Closets (not including janitor's closets) and private toilets.
- C. Fire-Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.

1. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
2. Temperature-Rise Limit: At vertical exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F above ambient after 30 minutes of standard fire-test exposure.
3. Cores: Provide core specified or mineral core as needed to provide fire-protection rating indicated.
4. Edge Construction: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed edges.
5. Pairs: Provide fire-retardant stiles that are listed and labeled for applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.

D. Particleboard-Core Doors:

1. Particleboard: ANSI A208.1, Grade LD-1 or Grade LD-2.
2. Blocking: Provide wood blocking in particleboard-core doors as follows:
 - a. 5-inch top-rail blocking, in doors indicated to have closers.
 - b. 10-inch bottom-rail blocking, in exterior doors and doors indicated to have kick, mop, or armor plates.
3. Provide doors with structural-composite-lumber cores instead of particleboard cores for doors indicated to receive exit devices.

E. Structural-Composite-Lumber-Core Doors:

1. Structural Composite Lumber: WDMA I.S.10.
 - a. Screw Withdrawal, Face: 700 lbf.
 - b. Screw Withdrawal, Edge: 400 lbf.

F. Mineral-Core Doors:

1. Core: Noncombustible mineral product complying with requirements of referenced quality standard and testing and inspecting agency for fire-protection rating indicated.
2. Blocking: Provide composite blocking with improved screw-holding capability approved for use in doors of fire-protection ratings indicated as follows:
 - a. 5-inch top-rail blocking.
 - b. 5-inch bottom-rail blocking, in doors indicated to have protection plates.
 - c. 5-inch midrail blocking, in doors indicated to have armor plates.
 - d. 5-inch midrail blocking, in doors indicated to have exit devices.
3. Edge Construction: At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.
 - a. Screw-Holding Capability: 550 lbf per WDMA T.M.-10.

2.3 PLASTIC-LAMINATE-FACED DOORS

A. Interior Solid-Core Doors:

1. Grade: Custom.
2. Plastic-Laminate Faces: High-pressure decorative laminates complying with NEMA LD 3, Grade HGS.
3. Colors, Patterns, and Finishes: As selected by Architect from laminate manufacturer's full range of products.

4. Exposed Vertical Edges: Plastic laminate that matches faces, applied before faces.
5. Exposed Top Edges: Hardwood edges for painting.
6. Core: Particleboard.
7. Construction: Five plies. Stiles and rails are bonded to core, then entire unit is abrasive planed before faces are applied. Faces are bonded to core using a hot press.

2.4 LIGHT FRAMES

- A. Metal Frames: Formed of 0.048-inch- thick, cold-rolled steel sheet; with baked-enamel- or powder-coated finish; at fire-rated doors, approved for use in doors of fire-protection rating indicated on Drawings.
 1. Basis-of-Design: Low Profile Lite Kit L-FRA 100 as manufactured by National Guyard Products.

2.5 FABRICATION

- A. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, BHMA-156.115-W, and hardware templates.
 1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.
 2. Metal Astragals: Factory machine astragals and formed-steel edges for hardware for pairs of fire-rated doors.
- B. Transom and Side Panels: Fabricate matching panels with same construction, exposed surfaces, and finish as specified for associated doors. Finish bottom edges of transoms and top edges of rabbeted doors same as door stiles.
 1. Fabricate door and transom panels with full-width, solid-lumber, rabbeted, meeting rails. Provide factory-installed spring bolts for concealed attachment into jambs of metal door frames.
- C. Openings: Factory cut and trim openings through doors.
 1. Light Openings: Trim openings with moldings of material and profile indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine doors and installed door frames, with Installer present, before hanging doors.
 1. Verify that installed frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
 2. Reject doors with defects.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Hardware: For installation, see Section 08 71 00 "Door Hardware."

- B. Installation Instructions: Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.
 - 1. Install fire-rated doors according to NFPA 80.

- C. Job-Fitted Doors: Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors. Machine doors for hardware. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.
 - 1. Clearances: Provide 1/8 inch at heads, jambs, and between pairs of doors. Provide 1/8 inch from bottom of door to top of decorative floor finish or covering unless otherwise indicated. Where threshold is shown or scheduled, provide 1/4 inch from bottom of door to top of threshold unless otherwise indicated.
 - a. Comply with NFPA 80 for fire-rated doors.
 - 2. Bevel non-fire-rated doors 1/8 inch in 2 inches at lock and hinge edges.
 - 3. Bevel fire-rated doors 1/8 inch in 2 inches at lock edge; trim stiles and rails only to extent permitted by labeling agency.

3.3 ADJUSTING

- A. Operation: Rehang or replace doors that do not swing or operate freely.

- B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION

SECTION 08 31 00 - ACCESS DOORS AND PANELS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Access door and frame units, fire-rated and non-fire-rated, in wall, and ceiling locations.

1.2 RELATED REQUIREMENTS

- A. Section 09 90 00 - Painting and Coating: Field paint finish.

1.3 SUBMITTALS

- A. Product Data: Provide sizes, types, finishes, hardware, scheduled locations, and details of adjoining work.
- B. Manufacturer's Installation Instructions: Indicate installation requirements.
- C. Project Record Documents: Record actual locations of each access unit and indicate equipment, device, or valve to which the panel provides access.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Access Doors:
 - 1. Acudor Products Inc: www.acudor.com.
 - 2. Access Panel Solutions, Inc.: www.accesspanelsolutions.com
 - 3. Milcor by Commercial Products Group of Hart & Cooley, Inc: www.milcorinc.com.
 - 4. Nystrom Building Products: www.nystrom.com. Basis of Specification.
 - 5. Substitutions: See Section 01 25 00 - Substitution Procedures.

2.2 ACCESS DOORS AND PANELS

- A. All Units: Factory fabricated, fully assembled units with corner joints welded, filled, and ground flush; square and without rack or warp; coordinate requirements with assemblies units are to be installed in.
- B. Units in Fire Rated Assemblies: Fire rating equivalent to the fire rated assembly in which they are to be installed.
 - 1. Provide products listed and labeled by UL or ITS (Warnock Hersey) as suitable for the purpose specified and indicated.

2.3 WALL AND CEILING UNITS

- A. General: The following access panel types are for selection as required whether or not indicated on drawings, unless indicated elsewhere in Division 15 or Division 16. 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.
- B. Door and Frame Units: Formed bonderized steel, 16 gauge minimum.
1. Sizes: As required to allow access, or minimum:
 - a. Walls: 18 x 18 inches.
 - b. Ceilings: 18 x 18 inches.
 - c. Equipment Access: 24 x 24 inches
 2. Hardware:
 - a. Hinge: 175 degree stainless steel piano hinge with removable pin.
 - b. Lock: Screw driver slot for quarter turn cam lock.
 3. Prime coat with baked on primer.
- C. Non-Fire Rated Door and Frame Units in Interior Walls:
1. In Cast-In-Place Concrete:
 - a. Model NT Series manufactured by Nystrom.
 2. In Masonry:
 - a. Model NT Series manufactured by Nystrom.
 3. In Gypsum Board on Steel Studs:
 - a. Model NW series manufactured by Nystrom.
 4. In Plaster on Metal Furring:
 - a. Model NP Series manufactured by Nystrom.
- D. Fire Rated Door and Frame Units in Walls:
1. In Cast-In-Place Concrete:
 - a. 1-1/2 hour B label fire rating.
 - b. Model IT Series manufactured by Nystrom.
 2. In Masonry:
 - a. 1-1/2 hour B label fire rating.
 - b. Model IT Series manufactured by Nystrom.
 3. In Gypsum Board on Steel Studs:
 - a. 1-1/2 hour B label fire rating.
 - b. Model IW Series manufactured by Nystrom.
 4. In Plaster on Metal Furring:
 - a. 1-1/2 hour B label fire rating.
 - b. Model IP Series manufactured by Nystrom.
- E. Non-Fire Rated Door and Frame Units in Ceilings:
1. In Gypsum Board on Metal Furring:
 - a. Model NW manufactured by Nystrom.
 2. In Plaster on Metal Furring:

- a. Model NP manufactured by Nystrom.
- F. Fire Rated Door and Frame Units in Ceilings:
- 1. In Gypsum Board on Metal Furring:
 - a. 1-1/2 hour B label fire rating.
 - b. Model IW manufactured by Nystrom.
 - 2. In Plaster on Metal Furring:
 - a. 1-1/2 hour B label fire rating.
 - b. Model IP manufactured by Nystrom.
- G. Insulated Door and Frame Units in Exterior Walls and Ceilings:
- 1. Provide lockable handle and neoprene gaskets.
 - 2. In Masonry, with masonry anchors:
 - a. Model XT manufactured by Nystrom.
 - 3. In Plaster on Metal Furring:
 - a. Model XT manufactured by Nystrom.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that rough openings are correctly sized and located.

3.2 INSTALLATION

- A. Install units in accordance with manufacturer's instructions.
- B. Install frames plumb and level in openings. Secure rigidly in place.
- C. Position units to provide convenient access to the concealed work requiring access.

END OF SECTION

SECTION 08 33 23 - OVERHEAD COILING DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Insulated service doors.

B. Related Sections:

1. Section 05 50 00 "Metal Fabrications" for miscellaneous steel supports.

1.2 ACTION SUBMITTALS

A. Product Data: For each type and size of overhead coiling door and accessory. Include the following:

1. Construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.
2. Rated capacities, operating characteristics, electrical characteristics, and furnished accessories.

B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.

1. Include plans, elevations, sections, details, and attachments to other work.
2. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Wiring Diagrams: For power, signal, and control wiring.
4. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
5. For exterior components, include details of provisions for assembly expansion and contraction and for excluding and draining moisture to the exterior.
6. Samples for Initial Selection: Manufacturer's finish charts showing full range of colors and textures available for units with factory-applied finishes.

C. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.

1. Curtain Slats: 12 inches long.
2. Bottom Bar: 6 inches long with sensor edge.
3. Hood: 6 inches square.

D. Delegated-Design Submittal: For overhead coiling doors indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of seismic restraints.
2. Summary of forces and loads on walls and jambs.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.

1.4 CLOSEOUT SUBMITTALS

- A. Special warranty.
- B. Maintenance Data: For overhead coiling doors to include in maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for both installation and maintenance of units required for this Project.
- 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.

1.6 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of doors that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, products that may be incorporated into the construction include, but are not limited to, the following:
 - 1. Cornell Iron Works, Inc.
 - 2. Cookson.
 - 3. Overhead Door Corporation.
- B. Source Limitations: Obtain overhead coiling doors from single source from single manufacturer.
 - 1. Obtain operators and controls from overhead coiling-door manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Accessibility Standard: Comply with applicable provisions in the Texas Accessibility Standards.
- B. Delegated Design: Design overhead coiling doors, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- C. Structural Performance, Exterior Doors: Exterior overhead coiling doors shall withstand the wind loads, the effects of gravity loads, and loads and stresses within limits and under conditions indicated according to SEI/ASCE 7.
 - 1. Wind Loads: As indicated on Drawings.

2. Deflection Limits: Design overhead coiling doors to withstand design wind load without evidencing permanent deformation or disengagement of door components.

2.3 INSULATED SERVICE DOOR ASSEMBLY

- A. Insulated Service Door: Overhead coiling door formed with curtain of interlocking metal slats.
- B. Operation Cycles: Provide overhead coiling door components and operators capable of operating for not less than 50,000 cycles. 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.
- C. Air Infiltration: Maximum rate of 0.4 cfm/sq. ft. at 15 and 25 mph when tested according to ASTM E283.
- D. Door Curtain Material: Galvanized steel.
- E. Door Curtain Slats: Flat profile slats of 1-7/8 inch to 3-1/4 inch center-to-center height.
 1. Insulated Slat Interior Facing: Same material as exterior face.
- F. Bottom Bar: Two angles, each not less than 1-1/2 by 1-1/2 by 1/8 inch thick; fabricated from manufacturer's standard galvanized steel, finished to match door.
- G. Curtain Jamb Guides - Surface-Mounted: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated.
- H. Hood: Match curtain material and finish.
 1. Shape: Round.
 2. Mounting: Face of wall.
- I. Retain Locking Device Assembly Subparagraph below if retaining locking device assembly option in Locking Devices Paragraph above.
 1. Locking Device Assembly: Single-jamb side locking bars, operable with cylinder.
- J. Electric Door Operator:
 1. Usage Classification: Standard duty, up to 25 cycles per hour and up to 90 cycles per day.
 2. Operator Location: Top or front of hood.
 3. Safety: Listed according to UL 325 by a qualified testing agency for commercial or industrial use; moving parts of operator enclosed or guarded if exposed and mounted at 8 feet or lower. Retain one of two options in Motor Exposure Subparagraph below or revise to suit Project. The operating environment, including hazardous conditions, may require other motor types and enclosure modifications.
 4. Motor Exposure: Interior.
 5. Motor Electrical Characteristics:
 - a. Horsepower: As indicated; if not indicated, sufficient to start, accelerate, and operate door in either direction from any position at a speed not less than 8 in./sec. and not more than 12 in./sec., without exceeding nameplate ratings or service factor.
 - b. Voltage: 115-V ac, single phase, 60 Hz.
 6. Emergency Manual Operation: Chain type.
 7. Obstruction-Detection Device: Automatic electric sensor edge on bottom bar.

- a. Sensor Edge Bulb Color: Black.
 - 8. Control Station(s): Where indicated on Drawings.
 - K. Curtain Accessories: Equip smoke doors with smoke seals.
 - L. Door Finish:
 - 1. Baked Enamel of Powder Coated Finish: Color as selected by Architect from manufacturer's full range.
- 2.4 MATERIALS, GENERAL
- 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.
- 2.5 DOOR CURTAIN MATERIALS AND CONSTRUCTION
- A. Door Curtains: Fabricate overhead coiling-door curtain of interlocking flat metal slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:
 - 1. Steel Door Curtain Slats: Zinc-coated (galvanized), cold-rolled structural steel sheet; complying with ASTM A 653/A 653M, with G90 zinc coating; nominal sheet thickness (coated) of 0.028 inch and as required to meet requirements.
 - 2. Insulation: Fill slats for insulated doors with manufacturer's R-8.0 thermal insulation complying with maximum flamespread and smoke developed indexes of 75 and 450, respectively, according to ASTM E 84. Enclose insulation completely within slat faces.
 - B. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain, and a continuous bar for holding windlocks.
- 2.6 HOOD
- A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Match curtain material and finish. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.
 - 1. Galvanized Steel: Nominal 0.028-inch- thick, hot-dip galvanized steel sheet with G90 zinc coating, complying with ASTM A 653/A 653M.
- 2.7 CURTAIN ACCESSORIES
- A. Weatherseals for Exterior Doors: Equip each exterior door with weather-stripping gaskets fitted to entire perimeter of door for a weathertight installation, unless otherwise indicated.

1. At door head, use 1/8-inch- thick, replaceable, continuous sheet secured to inside of hood.
2. At door jambs, use replaceable, adjustable, continuous, flexible, 1/8-inch-thick seals of flexible vinyl, rubber, or neoprene.

- B. Smoke Seals: Equip each fire or smoke door with replaceable smoke-seal perimeter gaskets or brushes for smoke and draft control as required for door listing and labeling by a qualified testing agency.

2.8 COUNTERBALANCING MECHANISM

- A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.
- B. Counterbalance Barrel: Fabricate spring barrel of manufacturer's standard hot-formed, structural-quality, welded or seamless carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than 0.03 in./ft.of span under full load.
- C. Spring Balance: One or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Secure ends of springs to barrel and shaft with cast-steel barrel plugs.
- D. Torsion Rod for Counterbalance Shaft: Fabricate of manufacturer's standard cold-rolled steel, sized to hold fixed spring ends and carry torsional load.
- E. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

2.9 ELECTRIC DOOR OPERATORS

- A. General: Equip service doors for electric door operation. Electric door operator assembly of size and capacity recommended and provided by door manufacturer for door specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, remote-control stations, control devices, integral gearing for locking door, and accessories required for proper operation.
1. Comply with NFPA 70.
 2. Provide control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70 Class 2 control circuit, maximum 24 V, ac or dc.
- B. Usage Classification: Electric operator and components capable of operating for not less than number of cycles per hour indicated for each door.
- C. Door Operator Location(s): Operator location indicated for each door.
1. Top-of-Hood Mounted: Operator is mounted to the right or left door head plate with the operator on top of the door-hood assembly and connected to the door drive shaft with drive chain and sprockets. Headroom is required for this type of mounting.
 2. Front-of-Hood Mounted: Operator is mounted to the right or left door head plate with the operator on coil side of the door-hood assembly and connected to the door drive shaft with drive chain and sprockets. Front clearance is required for this type of mounting.

- D. Motors: Reversible-type motor with controller (disconnect switch) for motor exposure indicated for each door assembly.
 - 1. Electrical Characteristics: Minimum as indicated for each door assembly. If not indicated, large enough to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec. and not more than 12 in./sec., without exceeding nameplate ratings or service factor.
 - 2. Operating Controls, Controllers, Disconnect Switches, Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.
 - 3. Coordinate wiring requirements and electrical characteristics of motors and other electrical devices with building electrical system and each location where installed.
 - E. Limit Switches: Equip each motorized door with adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.
 - F. Obstruction Detection Device: Equip motorized door with indicated external automatic safety sensor capable of protecting full width of door opening. For non-fire-rated doors, activation of device immediately stops and reverses downward door travel.
 - 1. Sensor Edge: Automatic safety sensor edge, located within astragal or weather stripping mounted to bottom bar. Contact with sensor activates device. Connect to control circuit using manufacturer's standard take-up reel or self-coiling cable.
 - a. Self-Monitoring Type: Four-wire configured device designed to interface with door operator control circuit to detect damage to or disconnection of sensor edge.
 - G. Control Station: Key switch in fixed location with positions labeled "Open" and "Close" and a push-button labeled "Stop."
 - 1. Interior units, full-guarded, recessed, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.
 - 2. Exterior units, full-guarded, standard-duty, surface-mounted, weatherproof type, NEMA ICS 6, Type 4 enclosure.
 - H. Emergency Manual Operation: Equip each electrically powered door with capability for emergency manual operation. Design manual mechanism so required force for door operation does not exceed 25 lbf.
 - I. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.
 - J. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.
- 2.10 GENERAL FINISH REQUIREMENTS
- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 - B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.11 STEEL AND GALVANIZED-STEEL FINISHES

- A. Manufacturer's Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.
 - 1. Color as selected by Architect from full range of manufacturer's premium powder coat finish options.
 - 2. Interior Curtain-Slat Facing: Match finish of exterior curtain-slat face.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates areas and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.
- B. Examine locations of electrical connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install overhead coiling doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.
- B. Install overhead coiling doors, hoods, and operators at the mounting locations indicated for each door.
- C. Accessibility: Install overhead coiling doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.

3.3 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Perform installation and startup checks according to manufacturer's written instructions.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 3. Test door closing when activated by detector or alarm-connected fire-release system. Reset door-closing mechanism after successful test.

3.4 ADJUSTING

- A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.
- B. Lubricate bearings and sliding parts as recommended by manufacturer.
- C. Adjust seals to provide weathertight fit around entire perimeter.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling doors.

END OF SECTION

SECTION 08 34 73.13 - METAL SOUND CONTROL DOOR ASSEMBLIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes metal sound control door assemblies.
- B. Related Requirements:
 - 1. Section 08 11 13 "Steel Doors and Frames" for frames not designated for special acoustical performance.
 - 2. Section 08 14 00 "Flush Wood Doors" for flush wood doors not designated for special acoustical performance.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include sound ratings, construction details, material descriptions, core descriptions, and finishes.
- B. Shop Drawings: For sound control door assemblies.
 - 1. Include elevations of each door design.
 - 2. Include details of sound control seals, door bottoms, and thresholds.
 - 3. Include details of doors, including vertical- and horizontal-edge details and metal thicknesses.
 - 4. Include frame details for each frame type, including dimensioned profiles and metal thicknesses.
 - 5. Include locations of reinforcements and preparations for hardware.
 - 6. Include details of each different wall opening condition.
 - 7. Include details of anchorages, joints, field splices, and connections.
 - 8. Include details of accessories.
 - 9. Include details of moldings, removable stops, and glazing.
 - 10. Include details of conduits and preparations for power, signal, and control systems.
- C. Samples for Verification: For each type of exposed finish not less than 3 by 5 inches.
 - 1. Doors and Frames: Samples approximately 12 by 12 inches.
 - a. Doors: Include section of vertical-edge, top, and bottom construction; automatic door bottom or gasket; core construction; glazing; and hinge and other applied hardware reinforcement.
 - b. Frames: Include profile, corner joint, floor and wall anchors, and seals.
- D. Schedule: Provide a schedule of sound control door assemblies prepared using same reference numbers for details and openings as those on Drawings. Coordinate with the Door Hardware Schedule.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Certificates: For each type of sound control door assembly.

- C. Product Test Reports: For each sound control door assembly, for tests performed by manufacturer and witnessed by a qualified testing agency.
- D. Sample Warranty: For manufacturer's special warranties.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For sound control door assemblies to include in maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver doors and frames palletized, wrapped, or crated to provide protection during transit and Project-site storage. Avoid the use of nonvented plastic.
 - 1. Provide additional protection to prevent damage to factory-finished units.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store doors and frames vertically under cover at Project site with head up. Place on minimum 4-inch- high wood blocking. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install metal sound control doors until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of sound control door assemblies that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Failure to meet sound rating requirements.
 - b. Faulty operation of sound seals.
 - c. Deterioration of metal frames, metal finishes, and other materials beyond normal use or weathering.
 - d. Doors that are warped (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section, or show telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.
 - 2. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Sound Rating: Provide sound control door assemblies identical to those of assemblies tested as sound-retardant units by an acoustical testing agency, and have the following minimum rating:
 - 1. STC Rating: Minimum STC 50 as calculated by ASTM E413 when tested in an operable condition according to ASTM E90.

2.2 METAL SOUND CONTROL DOORS

- A. Basis-of-Design: Subject to compliance with requirements, provide QuietSwing QS-50 Architectural Doors as manufactured by Noise Barriers; www.noisebarriers.com, or comparable products by alternate manufacturer.
- B. Source Limitations: Obtain metal sound control door assemblies, including doors, frames, sound control seals, hinges, thresholds, and other items essential for sound control, from single source from single manufacturer.
- C. Doors: Flush-design sound control doors, 2-1/2 inches thick; with manufacturer's standard sound-retardant core as required to provide STC rating indicated. Fabricate according to WDMA 1.S.1-A.
- D. Materials: Comply with Section 08 14 16 "Flush Wood Doors" for grade, faces, fabrication, finishing, and other requirements unless otherwise indicated.
 - 1. Glazing: As required by sound control door assembly manufacturer to comply with sound control requirements.
- E. Finishes:
 - 1. Factory prime sound control doors.

2.3 SOUND CONTROL FRAMES

- A. Frames: Fabricate sound control door frames with corners mitered, reinforced, and continuously welded the full depth and width of frame. Fabricate according to NAAMM-HMMA 865.
 - 1. Weld frames according to NAAMM-HMMA 820.
 - 2. Interior Frames: Fabricate from cold-rolled steel sheet unless otherwise indicated, 0.075-inch nominal thickness or thicker as required to provide STC rating indicated.
 - 3. Hardware Reinforcement: Fabricate according to NAAMM-HMMA 865 of same material as face sheets.
 - 4. Jamb Anchors:
 - a. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.048-inch nominal-thickness uncoated steel unless otherwise indicated.
 - 5. Floor Anchors: Not less than 0.079-inch nominal-thickness metallic-coated steel, and as follows:
 - a. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
 - b. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch height adjustment. Terminate bottom of frames at finish floor surface.

6. Ceiling Struts: Minimum 3/8-inch-thick by 2-inch- wide uncoated steel unless otherwise indicated.

B. Materials:

1. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B, suitable for exposed applications.
2. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
3. Powder-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching sound control door frames of type indicated.
4. Mineral-Fiber Insulation: Insulation composed of rock-wool fibers, slag-wool fibers, or glass fibers.

C. Finishes:

1. Prime Finish: Apply manufacturer's standard primer immediately after cleaning and pretreating.
 - a. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

2.4 HARDWARE

A. Sound Control Door Hardware: Manufacturer's standard sound control system, including head and jamb seals, door bottoms, and thresholds, as required by testing to achieve STC rating indicated.

1. Head and Jamb Seals: One of the following:
 - a. Neoprene Compression Seals: One-piece units consisting of closed-cell sponge neoprene seal held in place by metal retainer, with retainer cover of same material as door frame; attached to door frame with concealed screws.
 - b. Silicone Compression Seals: One-piece units consisting of silicone compression bulb and stabilizer flange; attached to door frame adhesively.
 - c. Magnetic Seals: One-piece units consisting of closed-cell sponge neoprene seal and resiliently mounted magnet held in place by metal retainer, with retainer cover of same material as door frame; attached to door frame with concealed screws.
2. Automatic Door Bottoms: Neoprene or silicone gasket, held in place by metal housing, that automatically drops to form seal when door is closed; mounted to bottom edge of door with screws.
 - a. Mounting: Mortised or semimortised into bottom of door or surface mounted on face of door as required by testing to achieve STC rating indicated.
3. Thresholds: Flat, smooth, unfluted type as recommended by manufacturer; fabricated from aluminum.
 - a. Finish: Clear anodic finish.

B. Other Hardware: Comply with requirements in Section 08 71 00 "Door Hardware."

2.5 SOUND CONTROL ACCESSORIES

A. Glazing: Manufacturers' standard factory-installed glazing.

2.6 FABRICATION

- A. Metal Sound Control Door Fabrication: Factory fit doors to suit frame-opening sizes indicated, with uniform clearances and bevels according to WDMA I.S.1-A unless otherwise indicated. Comply with final door hardware schedules and hardware templates.
1. Glazed Lites: Factory install glazed lites according to requirements of tested assembly to achieve STC rating indicated.
 2. Locate door hardware as indicated, or if not indicated, according to DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
 - a. Coordinate measurements of hardware mortises in steel frames to verify dimensions and alignment before factory machining.
- B. Sound Control Frame Fabrication: Fabricate sound control frames to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
1. Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible. Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated from same thickness metal as frames.
 2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 3. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
 4. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
 - 1) Three anchors per jamb up to 60 inches in height.
 - 2) Four anchors per jamb from 60 to 90 inches in height.
 5. Hardware Preparation: Factory prepare sound control frames to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping.
 - a. Reinforce frames to receive nontemplated mortised and surface-mounted door hardware.
 6. Tolerances: Fabricate frames to tolerances indicated in NAAMM-HMMA 865.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.

- B. Prior to installation, adjust and securely brace sound control door frames to the following tolerances:
 - 1. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - 2. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
 - 3. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - 4. Plumbness: Plus or minus 1/16 inch, measured at jambs on a perpendicular line from head to floor.

- C. Drill and tap doors and frames to receive nontemplated mortised and surface-mounted door hardware.

3.3 INSTALLATION

- A. General: Install sound control door assemblies plumb, rigid, properly aligned, and securely fastened in place; comply with manufacturer's written instructions.

- B. Frames: Install sound control door frames in sizes and profiles indicated.
 - 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
 - a. Install sound control frames with removable glazing stops located on secure side of opening.
 - b. Remove temporary braces only after frames or bucks have been properly set and secured.
 - c. Check squareness, twist, and plumbness of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
 - 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
 - a. Floor anchors may be set with powder-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
 - 3. Metal-Stud Partitions: Fully fill frames with mineral-fiber insulation.
 - 4. Ceiling Struts: Extend struts vertically from top of frame at each jamb to supporting construction above unless frame is anchored to masonry or to other structural support at each jamb. Bend top of struts to provide flush contact for securing to supporting construction above. Provide adjustable wedged or bolted anchorage to frame jamb members.
 - 5. Installation Tolerances: Adjust sound control door frames for squareness, alignment, twist, and plumbness to the following tolerances:
 - a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch, measured at jambs on a perpendicular line from head to floor.

- C. Doors: Fit sound control doors accurately in frames, within clearances indicated below. Shim as necessary.

1. Non-Fire-Rated Doors: Fit non-fire-rated doors accurately in frames with the following clearances:
 - a. Jambs: 1/8 inch.
 - b. Head with Butt Hinges: 1/8 inch.
 - c. Head with Cam-Lift Hinges: As required by manufacturer, but not more than 3/8 inch.
 - d. Sill: Manufacturer's standard.
 - e. Between Edges of Pairs of Doors: 1/8 inch.

 - D. Sound Control Seals: Where seals have been factory prefit and preinstalled and subsequently removed for shipping, reinstall seals and adjust according to manufacturer's written instructions.

 - E. Thresholds: Set thresholds in full bed of sealant complying with requirements in Section 07 92 00 "Joint Sealants."

 - F. Glazing: Comply with installation requirements in Section 08 80 00 "Glazing" and with sound control door assembly manufacturer's written instructions.
 1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.
- 3.4 ADJUSTING AND CLEANING
- A. Final Adjustments: Check and adjust seals, door bottoms, and other sound control hardware items right before final inspection. Leave work in complete and proper operating condition.

 - B. Remove and replace defective work, including defective or damaged sound seals and doors and frames that are warped, bowed, or otherwise unacceptable.
 1. Adjust gaskets, gasket retainers, and retainer covers to provide contact required to achieve STC rating.

 - C. Prime-Coat Touchup: Immediately after erection of frames, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible, rust-inhibitive, air-drying primer.

END OF SECTION

SECTION 08 41 13 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Exterior and interior aluminum-framed storefronts.
- B. Exterior and interior manual-swing aluminum doors.
- C. Related Sections include the following:
 - 1. Division 07 Section "Joint Sealants" for installation of joint sealants installed with aluminum-framed systems and for sealants to the extent not specified in this Section.
 - 2. Division 08 Section "Door Hardware" for hardware to the extent not specified in this Section.
 - 3. Division 08 Section "Glazing" for glazing requirements to the extent not specified in this Section.
 - 4. Division 26 Sections for electrical connections including conduit and wiring for door controls and operators installed on frames with factory installed electrical knock out boxes.

1.2 ACTION SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components, manufacturer's specifications, technical product data, performance values, standard details for the products specified, manufacturer's recommendation for installation and certification of the Installation Subcontractor, and profiles, and finishes for each type of product indicated
- B. Shop Drawings: For aluminum-framed systems. Include plans, elevations, sections, details, and attachments to other work prepared by the aluminum entrance manufacturer.
 - 1. Include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation. Data shall include deflection and stress analysis, joinery attachment analysis, and perimeter anchorage for each unique perimeter attachment condition.
 - 2. Include details of provisions for system expansion and contraction and for draining moisture occurring within the system to the exterior.
 - 3. For entrances, include hardware schedule and indicate operating hardware types, functions, quantities, and locations.
 - 4. Indicate location of each door type, component dimensions and field verified openings. Continue the door numbering system established in the Architectural Drawings. Elevations of each unit, drawn at 1/2-inch = 1'-0" scale. Indicate frame joinery. Full size section details of every typical member. Anchorage fastener type and location, straps/plates, and reinforcing steel as required by structural calculations. Glass and glazing. Perimeter sealants. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.
- C. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

- D. Fabrication Sample: Of each vertical-to-horizontal intersection of assemblies, made from 12-inch lengths of full-size components and showing details of the following:
 - 1. Joinery, including concealed welds.
 - 2. Anchorage.
 - 3. Expansion provisions.
 - 4. Glazing.
 - 5. Flashing and drainage.
- F. Entrance Door Hardware Schedule: Prepared by or under 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.
 - 1. Door manufacturer shall confirm that they have received approved hardware shop drawings and associated cut outs and templates for proper door preparation
- G. Delegated-Design Submittal: For aluminum-framed entrances and storefronts indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and testing agency.
- B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for aluminum-framed systems.
- C. Energy Performance Certificates: For aluminum-framed entrances and storefronts, accessories, and components, from manufacturer.
 - 1. Basis for Certification: NFRC-certified energy performance values for each aluminum-framed entrance and storefront.
- D. Quality-Control Program: Developed specifically for Project, including fabrication and installation, according to recommendations in ASTM C 1401. Include periodic quality-control reports.
- E. Welding certificates.
- F. Operation and Maintenance Manuals: Submit manufacturer's operating and maintenance manuals for entrance hardware per requirements of Division 01.
- G. Warranties: Special warranties specified in this Section.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Manufacturer capable of providing structural calculations, applicable independent product test reports, installation instructions, a review of the application method, customer approval and periodic field service representation during construction.

- B. Installer Qualifications: Capable of assuming engineering responsibility and performing work of this Section and who is acceptable to manufacturer.
 - 1. Engineering Responsibility: Preparation of data for aluminum-framed systems including Shop Drawings based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project and submission of reports of tests performed on manufacturer's standard assemblies.
- C. Source Limitations: Obtain each type of aluminum windows, entrance and storefront system and glazed aluminum curtain walls through one source from a single manufacturer of units identical to those specified.
- D. Testing Agency Qualifications: An independent agency qualified according to ASTM E 699 for testing indicated.
- E. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. 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.
 - 1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.
- F. Welding: Qualify procedures and personnel according to AWS D1.2, "Structural Welding Code--Aluminum.
- G. Installer's Certification: The Installation Subcontractor shall be a firm with a minimum of five years experience specializing in the proper installation of the specified aluminum entrance assemblies.
- H. Manufacturer's Certification: Manufacturers shall submit written certification that the Installation Subcontractors have been approved by them to install their products.
- I. Pre- Submittal Conference: Conduct conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier, Installer, and Contractor to review proper methods and procedures for installing aluminum framed entrances and storefronts and to verify installation of electrical knockout boxes and conduit at frames with electrified or access control hardware.

1.5 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.
 - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating aluminum-framed systems without field measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.6 WARRANTY

- A. Special Assembly Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of aluminum-framed systems that do not comply with requirements or that deteriorate as defined in this Section 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. Deterioration of metals and other materials beyond normal weathering.
 - d. Water leakage (weathertight) through fixed glazing and framing areas.
 - e. Failure of operating components to function properly.
- B. Warranty Period: Five years from date of Substantial Completion.
- C. Special Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
- D. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design aluminum-framed entrances and storefronts.
- B. General: Provide aluminum-framed systems tested within the last five years on a representative entrance assembly of the type, size and model proposed for this Project, including anchorage, capable of withstanding, without failure, the effects of the following:
 - 1. Structural loads.
 - 2. Thermal movements.
 - 3. Movements of supporting structure indicated on Drawings including, but not limited to, story drift and deflection from uniformly distributed and concentrated live loads.
 - 4. Dimensional tolerances of building frame and other adjacent construction.
 - 5. Failure includes the following:
 - a. Deflection exceeding specified limits.
 - b. Thermal stresses transferred 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 thermal and structural movements.
 - e. Loosening or weakening of fasteners, attachments, and other components.
 - f. Sealant failure.
 - g. Failure of operating units to function properly.
 - h. Glazing-to-glazing contact.
- C. Structural Loads:

- D. Provide system that is identical to systems that have been successfully tested by a qualified testing and inspecting agency to resist uplift pressure calculated according to IBC 2012 and the structural drawings based on the following criteria:
1. Design Wind Pressures: Refer to structural drawings
- E. Deflection of Framing Members:
1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans up to 13 feet 6 inches and to 1/240 of clear span plus 1/4 inch for spans greater than 13 feet 6 inches
 2. Deflection Parallel to Glazing Plane: Limited to amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components directly below to less than 1/8 inch and clearance between members and operable units directly below to less than 1/16 inch.
- F. Structural-Test Performance: Provide aluminum-framed systems tested according to ASTM E 330 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 less than 10 seconds.
- G. Air Infiltration: Provide aluminum-framed systems with maximum air leakage through fixed glazing and framing areas of 0.06 cfm/sq. ft. of fixed wall area when tested according to ASTM E 283 at a minimum static-air-pressure difference of 6.24 lbf/sq. ft..
- H. 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 E 331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 8.0 lbf/sq..
- I. Energy Performance: Certify and label energy performance according to NFRC as follows:
1. Average Thermal Conductance: Provide aluminum-framed systems with fixed glazing and framing areas having average U-factor of not more than 0.69 Btu/sq. ft. x h x deg F (3.92 W/sq. m x K) when tested according to AAMA 1503.
 2. Solar Heat Gain Coefficient: Fixed glazing and framing areas shall have a solar heat gain coefficient of no greater than 0.40 as determined according to NFRC 200.
 3. Condensation Resistance: Provide aluminum-framed systems with fixed glazing and framing areas having condensation-resistance factor (CRF) of not less than 53 when tested according to AAMA 1503.
- J. Thermal Movements: Provide aluminum-framed systems, including anchorage, 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.
1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
 2. Test Performance: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; noise or vibrations, and other detrimental effects or reduction of performance when tested according to AAMA 501.5.

- a. Test High Exterior Ambient-Air Temperature: That which produces an exterior metal-surface temperature of 240 deg F
- b. Test Low Exterior Ambient-Air Temperature: 30 deg F
- c. Test Interior Ambient-Air Temperature: 75 deg F

2.2 MANUFACTURERS

- A. Basis-of-Design Product: The design for aluminum-framed systems is based on named products by the Kawneer Company as listed. Subject to compliance with requirements, provide the named product or a comparable product by one of the following:
 1. Kawneer
 2. Oldcastle
 3. Atlas Architectural Metals
 4. EFCO Corporation
 5. TRACO
 6. Vistawall
 7. ARCH Aluminum & Glass, Amarlite
- B. Source Limitations: Obtain all components of aluminum-framed entrance and storefront system, including framing and accessories, from single manufacturer.
- C. Named Products:
 1. Type SF-01: Kawneer Trifab 451T Storefront, 2 inch by 4-1/2 inch, pre-assembled.

2.3 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
 1. Sheet and Plate: ASTM B 209 5005 H34 (anodic).
 2. Extruded Bars, Rods, Profiles, and Tubes: Prime billet 6063T6 ASTM B 221.
 3. Extruded Structural Pipe and Tubes: ASTM B 429.
 4. Structural Profiles: ASTM B 308/B 308M.
 5. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M.
- B. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer, complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.
 1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
 2. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
 3. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

2.4 FRAMING SYSTEMS

- A. Framing Members: Manufacturer's standard extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads.
 1. Construction: Framing members are composite assemblies of two separate extruded-aluminum components permanently bonded by an elastomeric material of low thermal conductance or Framing members are one-piece members that are internally slotted at regular intervals.

- B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
 - 1. Where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration, use self-locking devices.
 - 2. Reinforce members as required to receive fastener threads.
- D. Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123/A 123M or ASTM A 153/A 153M requirements.
- E. Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials. Form exposed flashing from sheet aluminum finished to match framing and of sufficient thickness to maintain a flat appearance without visible deflection.
 - 1. Provide sill flashing with end dams.
- F. Framing System Gaskets and Sealants: Manufacturer's standard recommended by manufacturer for joint type.
- G. Shims: PVC horseshoe shims in non-load bearing conditions and Korolath of New England, Inc. multipolymer plastic bearing shims per structural calculations and final shop drawing set. Frame Anchors: Anchors, heavy duty sleeve style, vibration resistant and removable, used to secure frame to concrete and grout filled concrete block shall be stainless steel. Type, size and spacing shall be per Project's structural requirements.

2.5 ENTRANCE DOOR SYSTEMS

- A. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing operation.
 - 1. Door Construction: 2- to 2-1/4-inch overall thickness, with minimum 0.125-inch- thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
 - 2. Door Design: Wide stile, modified; 4-1/2-inch nominal width; 3-inch top rail; 10-inch bottom rail.
 - 3. Glazing Stops and Gaskets: Square, snap-on, extruded-aluminum stops and preformed gaskets.
 - a. Provide nonremovable glazing stops on outside of door.

2.6 ENTRANCE DOOR HARDWARE

- A. Door Hardware: As specified in Division 08 Section "Door Hardware."
- B. Weather Stripping: Manufacturer's standard replaceable components.
 - 1. Compression Type: Made of ASTM D 2000, molded neoprene, or ASTM D 2287, molded PVC.
 - 2. Sliding Type: AAMA 701/702, made of wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing.

2.7 GLAZING SYSTEMS

- A. Glazing: As specified in Division 08 Section "Glazing."
- B. Glazing Gaskets: Manufacturer's standard compression types, replaceable, molded or extruded, that maintain uniform pressure and watertight seal.
- C. Spacers and Setting Blocks: Manufacturer's standard elastomeric types.
- D. Weatherseal Sealants: ASTM C 920 for Type S; Grade NS; Class 25; Uses NT, G, A, and O; chemically curing silicone formulation that is compatible with structural sealant and other system components with which it comes in contact; recommended by structural-sealant, weatherseal-sealant, and structural-sealant-glazed storefront manufacturers for this use.

2.8 ACCESSORIES

- A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
- B. Anchors: Three-way adjustable anchors that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.
- C. Mullion Extensions: Provide 11-1/2 inch rectangular cover projections in both vertical and horizontal applications as indicated on the Drawings.
- D. Window Stools: Provide manufacturer's standard window stools as indicated on the Drawings.
- E. Joint Sealants: For installation at perimeter of aluminum-framed systems, as specified in Division 07 Section "Joint Sealants."
- F. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil thickness per coat.

2.9 FABRICATION

- A. Form or extrude aluminum shapes before finishing.
- B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- C. Framing Members, General: Fabricate components that, when assembled, have the following characteristics:
 - 1. Profiles that are sharp, straight, and free of defects or deformations.
 - 2. Accurately fitted joints with ends coped or mitered.
 - 3. Means to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.
 - 4. Physical and thermal isolation of glazing from framing members.
 - 5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
 - 6. Provisions for field replacement of glazing from interior.
 - 7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

- D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.
- E. Door Frames: Reinforce as required to support loads imposed by door operation and for installing door hardware.
 - 1. At exterior doors, provide compression weather stripping at fixed stops.
 - 2. At interior doors, provide silencers at stops to prevent metal-to-metal contact. Install three silencers on strike jamb of single-door frames and two silencers on head of frames for pairs of doors.
 - 3. Electrical Wiring: Provide framing receiving electrified hardware with concealed wiring harness and standardized Molex™ plug connectors on one end to accommodate up to twelve wires. Coordinate connectors on end of the wiring harness to plug directly into the electric through wire hinge or pivot specified in hardware sets in Division 08 Section "Door Hardware."
- F. Doors: Reinforce doors as required for installing door hardware.
 - 1. At pairs of exterior doors, provide sliding-type weather stripping retained in adjustable strip and mortised into door edge.
 - 2. Electrical Wiring: Provide doors receiving electrified hardware with concealed wiring harness and standardized Molex™ plug connectors on both ends to accommodate up to twelve wires. Coordinate connectors on end of the wiring harness to plug directly into the electrified hardware and the electric thru wire hinge or pivot specified in hardware sets in Division 08 Section "Door Hardware."
- G. Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.
- H. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.10 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual" for recommendations for applying and designating finishes.
- B. Certified to meet AAMA 2604
- C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- D. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.11 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

- B. High-Performance Organic Finish: AAMA 2605; two-coat fluoropolymer finish containing not less than 70 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. Match curtain wall framing.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General:
 - 1. Comply with manufacturer's written instructions.
 - 2. Do not install damaged components.
 - 3. Fit joints to produce hairline joints free of burrs and distortion.
 - 4. Rigidly secure nonmovement joints.
 - 5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
 - 6. Seal perimeter and other joints watertight unless otherwise indicated.
- B. Metal Protection:
 - 1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
 - 2. Where aluminum is in contact with 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, without warp or rack.
- F. Install operable units level and plumb, securely anchored, and without distortion. Adjust weather-stripping contact and hardware movement to produce proper operation.
- G. Install glazing as specified in Division 08 Section "Glazing."
- H. Entrances: Install doors to produce smooth operation and tight fit at contact points.
 - 1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.

2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.
 - I. Entrance Installation Subcontractor shall furnish and supply isolation, caulking, and sealant materials required to caulk joints between entrance frames and other construction to provide a completely thermal broke, weathertight installation.
 - J. Provide positive connection between wall damp proofing and window frame with a waterproofing/damp proofing material.
 - K. Snap on glass stops shall be beveled type - square stops are to be fastened (door window stops).
 - L. Protect exterior glass from breakage immediately upon installation. Do not apply markers to substrates of glass. Remove nonpermanent labels and clean surfaces. Wash glass on both faces not more than 4 days prior to date scheduled for inspections indicated to establish date of substantial completion in each area of project. Wash glass by method recommended by glass manufacturer. Erection Tolerances: Install aluminum-framed systems to comply with the following maximum tolerances:
 1. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet; 1/4 inch over total length.
 2. Alignment:
 - a. Where surfaces abut in line, limit offset from true alignment to 1/16 inch.
 - b. Where surfaces meet at corners, limit offset from true alignment to 1/32 inch.
 - N. Diagonal Measurements: Limit difference between diagonal measurements to 1/8 inch.
- 3.3 ADJUSTING
- A. Entrances: Adjust operating hardware for smooth operation according to hardware manufacturers' written instructions.
 1. For 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 from the latch measured to the leading door edge.

3.4 FIELD QUALITY CONTROL

- A. Provide the services of the manufacturer's field representative to observe installation and make report. Report shall include date, time of day, weather conditions, and relevant information regarding installation observations and deficiencies corrected.
- B. See Section 01 40 00 - Quality Requirements, for independent testing and inspection requirements. Inspection will monitor quality of installation and glazing.
- C. Test installed storefront for water leakage in accordance with AAMA 501.2 as required for remediation of any known water leakage.
- D. Test randomly 3 each of installed storefront at 10 percent, 50 percent and 90 percent for the following:

1. Water leakage in accordance with ASTM E 1105 with a uniform test pressure difference of 8.00 lbf/sq ft . Test shall include storefront assembly and joint and flashing between storefront and adjacent construction.
 2. In addition, test same installed units for air leakage of 1.5 times the rate specified for laboratory testing under "Performance Requirements" Article, but not more than 0.09 cfm/sq. ft., of fixed wall area when tested according to ASTM E 783 at a minimum static-air-pressure difference of 6.24 lbf/sq. ft.
- E. Any remedial measures conducted on the test specimens to achieve passing results are to be incorporated into previous and future installations and reflected in the as-built shop drawings.

3.5 MAINTENANCE SERVICE

- A. 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 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. Use parts and supplies that are the same as those used in the manufacture and installation of original equipment.

END OF SECTION

SECTION 08 44 13 - GLAZED ALUMINUM CURTAIN WALLS

PART 1 - GENERAL

1.1 SYSTEM DESCRIPTION

- A. This is a performance specification and wall system manufacturer shall be responsible for complete design and engineering required to meet specified performance requirements within physical and aesthetic requirements established.
- B. Drawings and specifications are an outline of criteria and performance requirements for systems. Requirements specified or indicated by details are intended to establish basic dimensions of module and sight lines and profiles of members. Include modifications or additions required to meet specified requirements and maintain the visual design concept.
- C. Contract Documents do not necessarily indicate or describe total work required for completion of Work. Furnish and install all items required for complete installation.
- D. Dimension and profile adjustments may be made in proposed design in interest of fabrication or erection methods or techniques, weatherability factor, or ability of design and performance requirements, provided that design intent of Contract Documents is maintained.

1.2 PERFORMANCE REQUIREMENTS

- A. General: Provide custom curtain wall system and punched window designed to meet all performance criteria as specified here in including laboratory mock and testing.
- B. Delegated Design: Design wall system components, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated. Refer to Section 01 33 00 for information regarding delegated design submittals.
- C. See Field Quality Control for testing of assembly.
- D. Air and Water Infiltration: Design and install the glazed aluminum wall system for permanent resistance to air and water leakage through the system in accordance with the following.
 - 1. Air Infiltration: Air leakage through wall system shall not exceed 0.06 cfm per sq. ft. of wall area when tested in accordance with ASTM E 283 at a minimum static air pressure differential of 6.24 lbs per sq. ft.
 - 2. Water Penetration: There shall be no uncontrolled water leakage through the wall system, as defined in AAMA 501, when tested in accordance with ASTM E 331 at a minimum differential pressure of 12.0 lbs per sq. ft.
- E. Structural Performance: Design, engineer, fabricate, and install the glazed aluminum window system to withstand the effects of a wind load acting inward and outward, normal to the plane of the wall, when tested in accordance with ASTM E 330, with no material failures or permanent deformation of structural members.
 - 1. Meet load requirements in accordance with IBC-2009, ASCE 7-05, and the following structural design loads. The System will have been successfully tested for wind, and impact loads.
 - 2. Wind Load: As indicated.

- F. When tested according to ASTM E 330, performance criteria at design wind pressures and suction loads for metal members supporting glass and panels shall be as follows:
1. Perpendicular to the plane of the wall, net deflection of framing members shall be in accordance with AAMA T1R-A11-1996: Spans to 13'-6" (limit to L/175); Spans 13'-6" – 40'-0" (limit to L/240 + 1/4"). Span is defined as the distance between anchor centerlines; for cantilever, span is defined as two times the distance between anchor centerline and end of cantilever. Where a sealant joint occurs between a framing member and a relatively stiff building element, framing member deflection shall not exceed the elastic capacity of the sealant as published by the respective sealant manufacturer. Where a framing member runs continuously past a deflecting support, the support deflection shall be added to the member deflections.
 2. In the plane of the wall, deflection of framing members shall not exceed 0.125 inch. This includes horizontal rail sag due to dead load. Corner mullion in-plane deflection due to wind pressure shall be limited to 1/4 inch maximum at any time. Reduce allowable deflection if required for assembly and fit of component.
 3. Stresses shall not exceed allowable values established by the specifications listed in code standards. In no case shall allowable values exceed the yield stress. Where permitted by code, a 1/3 increase in allowable stress for wind or seismic load is generally acceptable, but not in combination with any reduction applied to combined loads.
 4. Where a framing member reaction is resisted by a continuous element, the maximum assumed effective length of the resisting element shall be four times the bearing length, but not more than one foot.
- G. Performance criteria at 1.5 times design pressure and loads for metal members supporting glass and panels shall be as follows:
1. Net permanent deflection of framing members shall not exceed 1/1000 times span.
 2. There shall be no failure or gross permanent distortion of framing members, anchors or connections.
 3. At connection points of framing members to anchors, combined movement of anchor relative to building structure, and framing member relative to anchor, shall not exceed 1/8 inch in any direction nor 1/16 inch set after load is removed.
 4. Not permitted: Vibration harmonics; wind whistles; noises caused by thermal movement; thermal movement transmitted to other building elements; loosening, weakening or fracturing of attachments or components of system.
- H. Movement provisions: Curtainwall vertical joints and horizontal stack joints shall provided noiseless accommodation for the accumulative movement as stated herein.
1. Support Structure: The curtainwall framing system shall accommodate the following movements and deflection of the support structure:
 - a. Differential deflection: $\pm 1/2"$
 - b. Interstory drift: $1/400$ of span
 - c. Column shortening: None
 2. Thermal Movement: Glazed aluminum wall system, including anchorage's, shall be capable of withstanding thermal movements resulting from an ambient temperature differential of 160deg F, and a metal surface temperature range of 180 deg F within the wall framing without causing buckling, damaging stresses on glazing, failure of joint sealant, damaging loads on fasteners, noise or vibration, and other detrimental effects.
 3. Manufacturing and Erection tolerance: The curtainwall system shall accommodate for fabrication and erection tolerance of each unit as follows:
 - a. Lateral and vertical fabrication tolerance: $\pm 1/32"$

- b. Lateral and vertical erection tolerance: $\pm 1/8"$
 - 4. Stack joints and starter sills shall transfer mull shear via strong axis metal splice only. Transfer of shear through weak axis bending of section members is not permitted.
 - I. Infiltrated and Condensation Water Management: System design shall include a continuous gutter and weeping infiltrated and condensate water out of system to the exterior above each ceiling line.
 - J. Dimensional Tolerances: Provide glazed aluminum wall system, including anchorage, that accommodates dimensional tolerances of building frames and other adjacent construction.
- 1.3 SUBMITTALS
- A. General: Submit each item in this Article according to the Conditions of the Contract.
 - B. Product Data: Include manufacturer's specifications for materials and fabrication, installation instructions, and recommendations for maintenance. Include test reports showing compliance with projects requirements where test method is indicated.
 - C. Shop Drawings: Provide complete shop drawings in AutoCad 2018 of all systems for the architect's approval. Drawings shall include elevations, floor plans, sections and full size details. Details shall be fully drawn and shall be full size. Drawings shall include the following information:
 - 1. All supports and braces required but not included in the structural drawings
 - 2. Joinery and internal weather seals – do not reference separate manual for this information
 - 3. Structural sealant joint dimensions and product, spacer material sizes and types
 - 4. Indicate glass types, sizes, and bite
 - 5. Complete glass schedule and description of each specific make up
 - 6. Metal thicknesses, alloy, temper and finish
 - 7. Fastener alloy, plating, diameter, length and spacing including shim material and maximum height.
 - 8. Field connections, weld sizes, anchorages, and fasteners
 - 9. Relative layout of walls, beams, columns and slabs with dimensions noted
 - 10. Dimension limits of movements for all moving joints
 - 11. Acceptable tolerance of adjacent materials and supports
 - 12. Spotting plans for preset inserts
 - 13. Indicate where and how the system deviates from Contract Documents
 - 14. All shop drawings including the first submittal shall have the seal and signature of professional engineer registered in the State of Montana. Shop drawings submitted without the seal of the engineer will be returned "Not Reviewed".
 - D. Provide structural calculations sealed by a professional engineer prepared in compliance with referenced documents and these specifications. Where specifications and code differ, the more severe requirements shall govern. Test reports are not an acceptable substitute for calculations. Calculations shall include the following information:
 - 1. Analysis for all applicable loads on framing members
 - 2. Analysis for all applicable loads on anchors, including anchors embedded in concrete
 - 3. Section property computations for framing members
 - 4. Seal and signature of professional engineer currently registered in the State of Montana.

- E. Samples: Provide pairs of samples of each aluminum finish type. Include 2 or more units in each sample set showing the extreme limits of variations expected in color and texture of finish.
- F. Test Reports: Provide test reports from a qualified independent testing agency evidencing compliance of the manufacturer's glazed aluminum wall system with performance requirements indicated based on comprehensive testing of manufacturer's current system.
- G. Manufacturer's Project Acceptance Document: Submit certification that manufacturer and installer will warrant glazed aluminum wall system for the specific site, design, details and application indicated for this Project.
 - 1. Submit sample copy of Manufacturer's Extended Warranty.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer to perform glazed aluminum wall work who has a minimum of 10 years specialized in installing glazed aluminum window wall systems similar to that required for this Project and who is acceptable to manufacturer of wall system.
 - 1. Installer Certification: Submit written certification from manufacturer of glazed aluminum wall system certifying that Installer is approved by manufacturer to install specified system.
 - 2. Installer's Field Supervision: Require Installer to maintain a full-time supervisor/foreman who is on job site during times that glazed aluminum wall system work is in progress and who is experienced in installing systems similar to type and scope required for this Project.
- B. Preconstruction Testing Service: The Contractor will employ and pay a qualified independent testing laboratory acceptable to the architect to perform the preconstruction testing indicated.
- C. Single-Source Responsibility: Provide glazed aluminum curtain wall system for the project from one source from a single manufacturer.
- D. Product Options: Information on Drawings and in Specifications establishes requirements for system's aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sight lines and relationships to one another and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by preconstruction testing for air infiltration, water leakage, and structural by wind load, or calculation for blast loading and impact resistance.
- E. Pre-installation Conference: Before beginning wall installation, conduct a pre-installation conference at the Project site with the wall system manufacturer, installer, and other interested parties to review procedures, schedules, and coordination of the wall installation with other elements of the Work.
- F. The final installation will be pressured tested in place with the specified glazing to verify the weather tightness of the entire system. The Contractor will repair the system as necessary to provide full warranties.

1.5 WARRANTY

- A. Finish Warranty: Provide written warranty signed by manufacturer and installer, agreeing to repair or replace work which exhibits defects in finish. "Defects" is defined to include, but is not limited to, peeling, chipping, chalking, fading, abnormal aging or deterioration, and failure to perform as required.
 - 1. Warranty Period for Fluoropolymer Finish: 20 years from date of Substantial Completion for color and film integrity.
 - 2. Weathertight (Leak) Warranty: 5 years from date of Substantial Completion.
- B. The Warranty submitted under this Section shall not deprive the Owner of other rights or remedies that the Owner may have under other provisions of the Contract Documents and is in addition to and runs concurrent with other warranties made by the Contractor under requirements of the Contract Documents.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with requirements, the following manufacturers are acceptable:
 - 1. Curtain Wall and Punched Window system
 - a. Kawneer 1600 Wall System 1(Basis of Design)
 - b. Oldcastle
 - c. Vistawall Architectural Products[
 - d. YKK AP America Inc.
 - 2. Profile
 - a. Curtain Wall: 2-1/2" x 7-1/2" deep
 - b. Punched Window: 2-1/2" x 6" deep

2.2 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated, complying with the requirements of standards indicated below.
 - 1. Sheet and Plate: ASTM B 209.
 - 2. Extruded Bars, Rods, Shapes, and Tubes: ASTM B 221.
 - 3. Extruded Structural Pipe and Tubes: ASTM B 429.
 - 4. Bars, Rods, and Wire: ASTM B 211.
 - 5. Welding Rods and Bare Electrodes: AWS A5.10.
- B. Steel Reinforcement: Complying with ASTM A 36 for structural shapes, plates, and bars; ASTM A 611 for cold-rolled sheet and strip; or ASTM A 570 for hot-rolled sheet and strip. Provide all horizontal and vertical interior reinforcement for the system performance requirements noted above. This steel includes, but is not limited to steel channels, tubes, and weld plates installed in mullions to the identified spans and wind loads. All steel in the glazed framing system or wet zone shall be hot dipped galvanized per ASTM A123. Steel supports above or behind the glazed framing sections shall receive a shop coat of Tnemec 10 Series modified alkyd primer.
- C. Glazing as specified in Division 8 Section "Glazing."

- D. Glazing Gaskets: Extruded silicone which complies with ASTM C 1115. All gaskets shall have factory molded corners. Refer to Division 8 Section "Glazing" for requirements. Color: Black
- E. Spacers, Setting Blocks, Gaskets, and Bond Breakers: Manufacturer's standard permanent, non-migrating types in hardness recommended by glass manufacturer, compatible with sealants, and suitable for system performance requirements. Color: Black
- F. Weatherseal Sealants: ASTM C 920 for Type S; Grade NS; Class 25; Uses NT, G, A, and O; chemically curing silicone formulation that is compatible with structural sealant and other system components with which it comes in contact; recommended by structural-sealant, weatherseal-sealant, and structural-sealant-glazed storefront manufacturers for this use.
- G. Concealed Metal Joint Sealant: Silicone sealant.
- H. Non-curing Metal Joint Sealant (concealed only): Tremco Curtainwall Sealant or equal
- I. Spacer Tape: Saint Gobain V2200 Thermalbond or equal.
- J. Brackets and Reinforcements: Manufacturer's designed high-strength aluminum or galvanized steel sections.
- K. Fasteners and Accessories:
 - 1. All screws and fasteners used to assemble the aluminum framing sections shall be Series 300 stainless steel
 - 2. All structural bolts, nuts, and washers at the main framing sections shall be series 300 stainless steel per ASTM F593, group I, condition CW.
 - 3. Expansion type anchor shall be series 304 stainless steel.
 - 4. Fasteners used to attach framing to CFMF in "dry zones" can be Elco Drill/Flex self drilling – tapping equal to SAE J 429, grade 5 with the Stalgard coating.
 - 5. Bolts and nuts used at concrete inserts in "dry zones" can be grade 8.8 high tensile steel mechanically galvanized per ASTM B 695 class 65 type 1.
- L. Concrete Inserts: Cast-iron, malleable iron or hot-dip galvanized steel inserts complying with ASTM A 386.
- M. Shims: Shims as structural connections shall be galvanized iron hole shims. Other shims can be high impact plastic horseshoe type.
- N. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements, except containing no asbestos, formulated for 30-mil thickness per coat.
- O. Insulation and Safing:
 - 1. Insulation at spandrel glass and other areas shall be equal to Thermafiber Firespan 90 3 inch thick Foil Backed suspended in place with Impasse galvanize hanger clips. Seal all perimeter and intermediate joints and penetrations with 2 inch wide foil tape. Provide galvanized backer bars where required to resist bowing caused by safing.
 - 2. Safing shall be equal to 4 inch thick Thermafiber held in place with galvanized impaling clips 24 inch OC and approved smoke seal.
 - 3. Provide mull covers and anchor wraps in 1 inch thick Thermafiber Firespan or equal. Attach mull covers with spiral type anchors.

2.3 ENTRANCES

- A. Doors: Provide manufacturer's designed 2 inch thick glazed doors. Mechanically fasten corners with reinforcing brackets that are deep penetration and fillet welded or that incorporate concealed tie-rods. Reinforce door and frame walls for hardware installation.
 - 1. Glazing Stops and Gaskets: Provide manufacturer's standard square snap-on extruded-aluminum glazing stops and preformed gaskets.
 - 2. Stile Design: 3-1/2 inch medium stile, thermally improved. Provide 5 inch top and bottom rail.
 - 3. Selected Product: Entry system compatible with curtainwall system noted above. Finish same as curtainwall.
- B. Brackets, Miscellaneous Steel and Reinforcements: Provide manufacturer's designed brackets and additional reinforcements that are compatible with adjacent materials. Provide nonstaining, nonferrous shims for aligning system components.
- C. Security astragal bar: Provide a full length moveable astragal bar, which locks in place upon depression of the panic bar.
- D. Fasteners and Accessories: stainless steel.
 - 1. Reinforce members as required to retain fastener threads.
 - 2. Do not use exposed fasteners, except for hardware application. For hardware application, use countersunk Phillips flat-head machine screws finished to match framing members or hardware being fastened, unless otherwise indicated.
- E. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123 or ASTM A 153 requirements.
- F. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing, compatible with adjacent materials, and of type recommended by manufacturer.
- G. Concealed Flashing: Dead-soft, 0.018-inch-thick stainless steel, complying with ASTM A 666, of type selected by manufacturer for compatibility with system.
- H. Weather Stripping: Manufacturer's standard replaceable weather stripping as follows:
 - 1. Compression Weather Stripping: Molded neoprene complying with ASTM D 2000 requirements or molded PVC complying with ASTM D 2287 requirements.
 - 2. Sliding Weather Stripping: Wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing complying with AAMA 701 requirements.

2.4 HARDWARE

- A. General: Coordinate systems with the hardware specified. Finish exposed parts to match door finish, unless otherwise indicated.

2.5 FABRICATION

- A. Fabricate components with minimum clearances and shim spacing around perimeter of assembly, yet enabling installation and dynamic movement of perimeter seal.
- B. Accurately fit and secure joints and corners. Make joints flush, hairline , and weatherproof.

- C. Prepare components to receive anchor devices. Fabricate anchors.
- D. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.
- E. Arrange fasteners and attachments to conceal from view.
- F. Reinforce framing members for imposed loads.
- G. Finishing: Apply factory finish to all surfaces that will be exposed in completed assemblies.
 - 1. Touch-up surfaces cut during fabrication so that no natural aluminum is visible in completed assemblies, including joint edges.

2.6 FINISHES

- A. General: Comply with the NAAMM "Metal Finishes Manual" for recommendations relative to application and designations of finishes.
- B. Finish designations prefixed by "AA" conform to the system established by the Aluminum Association for designating aluminum finishes.
- C. High-Performance Organic Coating: AAMA 2605; two-coat fluoropolymer finish containing not less than 70 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: As indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates surfaces to receive glazed aluminum wall system and associated work and conditions under which work will be installed. Do not proceed with installation until unsatisfactory conditions have been corrected in a manner acceptable to Installer. Starting work with in a particular area will be construed as applicator's acceptance of surface conditions.

3.2 PREPARATION

- A. Furnish inserts for setting in concrete formwork and similar work required to support glazed aluminum wall work.
- B. Field measure and verify governing dimensions, including floor elevations, floor-to-floor heights, minimum clearance between wall system and structural frames and other permissible dimensional tolerances in building frame.
- C. Metal Protection: Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

3.3 INSTALLATION

- A. Comply with manufacturer's instructions for installing fabricated wall components, with particular care and attention to preservation of applied finishes. Discard or remove and replace damaged members.
- B. Do not cut, trim, weld or braze component parts during erection, in any manner which would damage finish, decrease strength or result in visual imperfection or failure in performance of construction.
- C. Secure to structure with non-staining and non-corrosive shims, anchors, fasteners, spacers and fillers.
- D. Maintain minimum clearance of one inch between inside face of wall system and outside face of building structure. Allow 3/8 inch minimum for sealant between wall system and adjacent construction.
- E. Anchor components securely in place. Shim and allow for movement resulting from changes in thermal conditions. Provide separators and isolators to prevent corrosion, electrolytic deterioration, and freeze-up of moving joints.
- F. Glazing: Install glass and glazing material in accordance with manufacturer's recommendations and as specified. Comply with requirements specified in Division 8 Section "Glazing".
- G. Sealants and joint fillers: Seal perimeter of glazed aluminum wall system. Comply with requirements specified in Division 7 Section "Joint Sealers".
- H. Coordinate with security equipment and electrical requirements. Wiring shall be concealed.
- I. Erection Tolerances: Install components plumb, level, accurately aligned, and located in reference to column lines and floor levels. Adjust work to conform to the tolerances indicated below. Tolerances indicated below are maximum and are not cumulative.
 - 1. Plumb: 1/8 inch in 16 feet and 1/4 inch in 40 feet.
 - 2. Level: 1/8 inch in 20 feet and 1/4 inch in 40 feet.
 - 3. Alignment: Limit offset of member alignment to 1/16 inch where surfaces are flush or less than 1/2 inch out of flush and separated by less than 2 inches by a reveal or protruding work; otherwise limit offsets to 1/8 inch.
 - 4. Location: Limit variation from plane or location shown to 1/8 inch in 12 feet or 1/2 inch in any total length.

3.4 FIELD QUALITY CONTROL TESTS

- A. Engage an authorized testing agency to test installed glazed aluminum wall system in accordance with AAMA 501.3 and ASTM E 1105 Static Pressure Water test.
 - 1. Perform one test at the beginning of the wall system erection. Perform additional tests at the completion of the curtain wall and associated systems.
 - 2. Satisfactory results of the check do not in any way relieve the Contractor from conforming with requirements of the approved shop drawings and job specifications.
 - 3. Such remedial measures as are found necessary and effective in eliminating leakage in the area checked shall be used in fabricating and/or installing the remainder of the wall on the building.

3.5 PROTECTION

- A. Provide shop installed strippable masking on all interior venerable surfaces such as sills and lower horizontal sections to minimize damage of finishes.
- B. Final cleaning and removal of the masking is by the general contractor.

END OF SECTION

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. 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 "Door Hardware Schedule".
 - 2. Division 08 Section "Steel Doors and Frames".
 - 3. Division 08 Section "Aluminum-Framed Entrances and Storefronts".
 - 4. Division 08 Section "Plastic Laminate Faced Wood Doors".
- 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:
 - 1. ANSI/BHMA Certified Product Standards - A156 Series
 - 2. UL10C – Positive Pressure Fire Tests of Door Assemblies

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. Proof of Certification: Provide copy of manufacturer(s) official certification or accreditation document indicating proof of status as a qualified installer of Windstorm assemblies.
- E. 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.
- F. 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.

- G. 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 Submittals.

1.4 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. Installer Qualifications: A minimum 3 years documented experience 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.
- C. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying 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.
- D. Integrated Wiegand, Wireless, and IP-Enabled Access Control Products Supplier Qualifications: Integrated access control products and accessories are required to be supplied and installed through current members of the ASSA ABLOY "Authorized Channel Partner" (ACP) and "Certified Integrator" (CI) programs. Suppliers are to be factory trained, certified prior to project bid, and a direct purchaser of the specified product. Installers are to be factory trained, certified prior to project bid, and are responsible for commissioning, servicing, and warranting the installed equipment specified for the project.
- 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 demonstrating compliance with the referenced 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 to manufacturer's instructions and recommendations and according to approved schedule.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site.
- 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 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".

1.6 COORDINATION

- A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing 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.

1.7 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. Standard Warranty Period: One year from date of Substantial Completion, unless otherwise indicated.
 - D. Special Warranty Periods:
 - 1. Lifetime for mortise locks and latches.
 - 2. Five years for exit hardware.
 - 3. Ten years for electric latch retraction exit motors
 - 4. Twenty-five years for manual surface door closer bodies.
 - 5. Two years for electromechanical door hardware.
 - 6. Lifetime for SN200 readers.
- 1.8 MAINTENANCE SERVICE
- A. 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 door hardware.
 - B. OWNER STOCK – See Attic Stock at the end of Hardware Schedule.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

- A. General: Provide door hardware for each door to comply with requirements in Door Hardware Sets and each referenced section that products are to be supplied under.
- B. Designations: Requirements for quantity, item, size, finish or color, grade, function, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Sets at the end of Part 3. Products are identified by using door hardware designations, as follows:
- C. Named Manufacturer's Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.
- D. Substitutions: Requests for substitution and product approval for inclusive mechanical and electromechanical door hardware in compliance with the specifications must be submitted in writing and in accordance with the procedures and time frames outlined in Division 01, Substitution Procedures. Approval of requests is at the discretion of the architect, owner, and their designated consultants.

2.2 HANGING DEVICES

- A. Hinges: ANSI/BHMA A156.1 certified butt hinges with number of hinge knuckles as specified in the Door Hardware Sets.
1. Quantity: Provide the following hinge quantity, unless otherwise indicated:
 - a. Two Hinges: For doors with heights up to 60 inches
Three Hinges: For doors with heights 61 to 90 inches
Four Hinges: For doors with heights 91 to 120 inches
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
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 where indicated in the Hardware Sets or on Drawings:
 - a. Non-removable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for the all out-swinging lockable doors.
 5. Acceptable Manufacturers:
 - a. Hager Companies (HA).
 - b. McKinney Products (MK).
 - c. Stanley Hardware (ST).
- B. Continuous Geared Hinges: ANSI/BHMA A156.26 Grade 1-600 certified continuous geared hinge. with minimum 0.120-inch thick extruded 6060 T6 aluminum alloy hinge leaves and a minimum overall width of 4 inches. Hinges are non-handed, reversible and fabricated to template screw locations. Factory trim hinges to suit door height and prepare for electrical cut-outs.
1. Acceptable Manufacturers:
 - a. McKinney Products (MK).
 - b. Pemko Manufacturing (PE).
 - c. Stanley Hardware (ST).

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. Acceptable Manufacturers:
 - a. Pemko Manufacturing (PE) – EL-CEPT Series.
 - b. Securitron (SU) - EL-CEPT Series.
 - c. Stanley Hardware (ST) EPT-12C 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 Products (MK) - Electrical Connecting Kit: QC-R001.
 - b. McKinney Products (MK) - Connector Hand Tool: QC-R003.

2.4 DOOR OPERATING TRIM

- A. Flush Bolts and Surface Bolts: ANSI/BHMA A156.3 and A156.16, Grade 1, certified.
1. Manual flush bolts to be furnished with top rod of sufficient length to allow bolt 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. Acceptable Manufacturers:
 - a. Ives (IV).
 - b. Rockwood Manufacturing (RO).
 - c. Trimco (TC).
- B. Door Push Plates and Pulls: ANS/BHMA A156.6 certified door pushes and pulls 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 inchthick, 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. Fasteners: Provide manufacturer's designated fastener type as indicated in Hardware Sets.
 5. Acceptable Manufacturers:
 - a. Ives (IV).
 - b. Rockwood Manufacturing (RO).
 - c. Trimco (TC).

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. Source Limitations: Obtain each type of keyed cylinder and keys from the same source manufacturer as locksets and exit devices, unless otherwise indicated.
1. Acceptable Manufacturers:

- a. Stanley Best (BE).
 - b. Sargent Cylinder Housings
 - c. No Substitution.
- C. Cylinders: Original manufacturer cylinders complying with the following:
1. Mortise Type: Threaded cylinders with rings and cams to suit hardware application.
 2. Rim Type: Cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
 3. Bored-Lock Type: Cylinders with tailpieces to suit locks.
 4. 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.
 5. Keyway: Match Facility Standard.
- D. Keying System: Each type of lock and cylinders to be factory keyed.
1. Conduct specified "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: Key locks to Owner's existing system.
- E. Key Quantity: Provide the following minimum number of keys:
1. Change Keys per Cylinder: Two (2)
 2. Twenty construction cores
 3. 50 Key Blanks – Best "A" Keyway
- F. Construction Keying: Provide temporary keyed construction cores. Green Best Cores No Substitution . All Best temporary cores to be returned to the district at the end of the project.
- G. 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.
- H. 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. Provide a new cabinet to all new construction projects. Use Lund 1205-B as a basis of design.
1. Acceptable Manufacturers:
 - a. Lund Equipment (LU).
 - b. MMF Industries (MM).
 - c. Telkee (TK).
- 2.6 MECHANICAL LOCKS AND LATCHING DEVICES
- A. Mortise Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.13. Locksets are to be manufactured with a corrosion resistant steel case and be field-reversible for handing without disassembly of the lock body.
1. Acceptable Manufacturers
 - a. Sargent Manufacturing (SA) 8200 Series – No substitutions
 - b. Sargent Manufacturing (SA) 10X Series - No substitutions

- 1) Use at student restrooms or as directed by Cy Fair ISD

2.7 AUXILIARY LOCKS

- A. Tubular Deadlocks: Deadlocks to be products of the same source manufacturer and keyway as other specified locksets.
 1. Acceptable Manufacturers:
 - a. Marks (MX) - 130 Series.
 - b. Sargent Manufacturing (SA) – 480 Series.

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. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.
- B. Standards: Comply with the following:
 1. Strikes for Mortise Locks and Latches: BHMA A156.13.
 2. Strikes for Auxiliary Deadlocks: BHMA A156.5.
 3. 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. 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.
 2. 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.
 3. 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.
 4. 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.
 5. 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.
 6. Rail Sizing: Provide exit device rails factory sized for proper door width application.

7. Through Bolt Installation: For exit devices and trim as indicated (TB) in Door Hardware Sets.
8. Provide Less Dogging (LD) at all exit devices.
9. Add 31- Prefix to all exit devices being provided at two inch aluminum doors.
10. No self-tapping screws allowed.

B. Conventional Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 certified panic and fire exit hardware devices furnished in the functions specified in the Hardware Sets. Exit device latch to be stainless steel, pullman type, with deadlock feature.

1. Acceptable Manufacturers:
 - a. Sargent Manufacturing (SA) - 80 Series.
 - b. No Substitution.

C. Tube Steel Removable Mullions: ANSI/BHMA A156.3 removable steel mullions with malleable-iron top and bottom retainers and a primed paint finish.

1. Provide keyed removable feature where specified in the Hardware Sets.
2. Provide stabilizers and mounting brackets as required.
3. Provide electrical quick connection wiring options as specified in the hardware sets.
4. Acceptable Manufacturers:
 - a. Stanley Precision (PR) - 822 Series.
 - b. No Substitution.

2.10 INTEGRATED WIEGAND OUTPUT ACCESS CONTROL EXIT DEVICES

A. Wiegand Output Integrated Card Reader Exit Hardware: Wiegand output ANSI 156.3 Grade 1 rim, mortise, and vertical rod exit device hardware with integrated proximity card reader, latchbolt and touchbar monitoring, and request-to-exit signaling, in one complete unit. Hard wired, solenoid driven locking/unlocking control of the lever handle exit trim with 3/4" throw latch bolt. U.L listed and labeled for either panic or "fire exit hardware" for use on up to 3 hour fire rated openings. Available with or without keyed high security cylinder override.

1. Open architecture, hard wired platform supports centralized control of locking units with new or existing Wiegand compatible access control systems. Inside push bar (request-to-exit) signaling and door position (open/closed status) monitoring (via separately connected DPS).
2. Reader supports either HID 125 kHz proximity (up to 39 bits, including Corporate 1000) or 13.56 MHz (2K-32K) iClass® credentials.
3. 12VDC external power supply required for reader, with optional 24VDC operation available with iClass® reader (125 kHz reader is always 12VDC). 24VDC required for solenoid operated exit trim (12VDC if applicable). Fail safe or fail secure options.
4. Installation requires only one cable run from the exit hardware to the access control panel without requirements for additional proprietary lock panel interface boards or modules.
5. Acceptable Manufacturers:
 - a. Sargent Manufacturing (SA) - SN – 56-SN20080 Series Exits. x SPAR04867
 - b. Sargent Manufacturing (SA) - SN – SN2008200 Series Locks.
 - c. No Substitution.

2.11 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 including installation and adjusting information on inside of cover.
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. Cycle Testing: Provide closers which have surpassed 15 million cycles in a test witnessed and verified by UL.
4. 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 physically handicapped, provide units complying with ANSI ICC/A117.1.
5. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.
6. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.
7. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates, and through-bolt and security type fasteners as required for proper installation.
8. Through Bolt Installation: All door closers are to be installed with (TB) through bolting as indicated in Door Hardware Sets.
9. No self-tapping screws allowed.

B. Door Closers, Surface Mounted (Heavy Duty): ANSI/BHMA A156.4, Grade 1 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. Acceptable Manufacturers:
 - a. Sargent Manufacturing (SA) – TB 351 Series.

2.12 SURFACE MOUNTED CLOSER HOLDERS

A. Electromagnetic Door Holders: Certified ANSI A156.15 electromagnetic door holder/releases with a minimum 20 to 40 pounds holding power and single coil construction able to accommodate 12VDC, 24VAC, 24VDC and 120VAC. Coils to be independently wound, employing an integral fuse and armatures to include a positive release button.

1. Acceptable Manufacturers:
 - a. LCN Door Closers (LC) - SEM7800 Series.
 - b. Rixson (RF) - 980/990 Series.
 - c. Sargent Manufacturing (SA) - 1560 Series.

2.13 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. Protection Plates: ANSI/BHMA A156.6 certified protection plates (kick, armor, or mop), fabricated from the following:
 - a. Stainless Steel: 300 grade, 050-inchthick.
4. Options and fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets. Provide countersunk screw holes.
5. Acceptable Manufacturers:
 - a. Ives (IV).
 - b. Rockwood Manufacturing (RO).
 - c. Trimco (TC).

2.14 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 certified 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. Acceptable Manufacturers:
 - a. Ives (IV).
 - b. Rockwood Manufacturing (RO).
 - c. Trimco (TC).
- C. Overhead Door Stops and Holders: ANSI/BHMA A156.6, Grade 1 certified 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. Acceptable Manufacturers:
 - a. Do not use overhead stops/holders

2.15 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 UBC 7-2, Fire Tests of Door Assemblies.
- D. No Replaceable Seal Strips allowed: Provide only those units where they can be screw applied..
- E. Acceptable Manufacturers:
 - 1. National Guard Products (NG).
 - 2. Pemko Manufacturing (PE).
 - 3. Reese Enterprises, Inc. (RE).

2.16 ELECTRONIC ACCESSORIES

- A. Door Position Switches: Door position magnetic reed contact switches specifically designed for use in commercial door applications. On recessed models the contact and magnetic housing snap-lock into a 1" diameter hole. Surface mounted models include wide gap distance design complete with armored flex cabling. Provide SPDT, N/O switches with optional Rare Earth Magnet installation on steel doors with flush top channels.
 - 1. Acceptable Manufacturers:
 - a. Provided by Security
- B. Switching Power Supplies: Provide UL listed or recognized filtered and regulated power supplies. Provide single, dual, or multi-voltage units as shown in the hardware sets. Units must be expandable up to eight Class 2 power limited outputs. Units must include the capability to incorporate a battery backup option with integral battery charging capability in addition to operating the DC load in event of line voltage failure. Provide the least number of units, at the appropriate amperage level, sufficient to exceed the required total draw for the specified electrified hardware and access control equipment.
 - 1. Acceptable Manufacturers:
 - a. Provided by Security

2.17 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.

2.18 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. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
 - 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. Integrated Wiegand access control products are required to be installed through current members of the ASSA ABLOY "Certified Integrator" (CI) program.
- D. 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.

- 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.
- G. No self-tapping screws allowed.

3.4 FIELD QUALITY CONTROL

- A. Field Inspection: Supplier will perform a final inspection of installed door hardware and state in report whether work complies with or deviates from requirements, including whether door hardware is properly installed, operating and adjusted.

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.
- B. Final Adjustment: Installer shall return and make final adjustment of all hardware once all air conditioning test and balance is complete. Final adjustment shall be made while air conditioner system is operating. Coordinate with General Contractor and Owner.

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.
- B. Manufacturer's Abbreviations:

1. MK - McKinney
2. OT - OTHER
3. PE - Pemko
4. RO - Rockwood
5. PR - Precision
6. MX - Marks
7. SA - Sargent
8. AD - Adams Rite
9. BE - Best Access Systems
10. HS - HES
11. SU - Securitron
12. KD - Keedex
13. LO - Locinox

Hardware Sets

****At existing doors / frames, all conditions must be field verified prior to order.**

At aluminum frames, gasket is by frame manufacturer.

****Add 2891APK gasketing to all exterior hollow metal doors.**

Hardware Sets based on plans dated 08-28-2024
10/7/2024 – Revised based on 75% Owner Note Review

Set: 1.0

Doors: G1011B

Description: **Sgl Ext - ASF - Exit -SN200 - Closer w/Stop Arm- Access Control

| | | | | | |
|---|--|----------------------------------|----|-------|----|
| 1 | Continuous Hinge CFM SLF-HD1 PT x Dr. Ht. | | PE | | |
| 1 | Electric Power Transfer EL-CEPT | 630 | SU | | |
| 1 | Rim Exit xSPAR04867/NC-E11/NC-E35 | 19 LD TB 43 70 56-SN200-8504 862 | | US32D | SA |
| 1 | Interchangeable Core I/CK-7 | 626 | BE | | |
| 1 | Const. Core 7190224 | Green | BE | | |
| 1 | Door Closer TB 351 PS | EN | SA | | |
| 1 | Kit 581-1/ 581-2 as required | EN | SA | | |
| 1 | Sweep IDF/MDF/Alum 18061CNB x Dr. Width | | PE | | |
| 1 | Threshold 2005AT MSES25SS X Opening Width | | | PE | |
| 1 | Perimeter Seal By door mfrgr | OT | | | |
| 1 | ElectroLynx Harness QC-C1500P | | MK | | |
| 2 | ElectroLynx Harness QC-C***P (length as req'd) | | MK | | |
| 1 | Door Position Switch By Security. | | OT | | |
| 1 | Power Supply Provided by security | | SU | | |

Notes: Operation: Doors normally closed and locked. Valid card at the card reader retracts the latch on the active leaf for entry. Free egress at all times. Door status monitored. Confirm specified hardware is compatible with aluminum door manufacturer.

826 Vandal Pull is not compatible with a narrow stile panic device

Set: 2.0

Doors: H131B

Description: **Pr Ext - ASF - Exit Device- SN200/DT - Mullion - Closer w/Stop Arm -Access Control

| | | | | | |
|---|---|----------------------------------|----|-------|----|
| 1 | Continuous Hinge CFM SLF-HD1 x Dr. Ht. | | PE | | |
| 1 | Continuous Hinge CFM SLF-HD1 PT x Dr. Ht. | | PE | | |
| 1 | Electric Power Transfer EL-CEPT | 630 | SU | | |
| 2 | Stabilizer ST989 | Dull Black | PR | | |
| 1 | Spacer MCS822 689 | PR | | | |
| 1 | Mullion 822 (FL as req) | 600 | PR | | |
| 1 | Rim Exit x SPARNC-E11 | LD 19 TB 43 8510 862 | | US32D | SA |
| 1 | Rim Exit xSPAR04867/NC-E11/NC-E35 | 19 LD TB 43 70 56-SN200-8504 862 | | US32D | SA |
| 2 | Interchangeable Core I/CK-7 | 626 | BE | | |
| 1 | Rim Cylinder 70 34 X #90 - 1/2 | US32D | SA | | |
| 1 | Const. Core 7190224 | Green | BE | | |
| 2 | Door Closer TB 351 PS | EN | SA | | |
| 2 | Kit 581-1/ 581-2 as required | EN | SA | | |
| 2 | Sweep IDF/MDF/Alum 18061CNB x Dr. Width | | PE | | |
| 1 | Threshold 2005AT MSES25SS X Opening Width | | | PE | |

| | | | | |
|---|----------------------|----------------------------|----|----|
| 1 | Perimeter Seal | By door mfr | OT | |
| 1 | ElectroLynx Harness | QC-C1500P | | MK |
| 2 | ElectroLynx Harness | QC-C***P (length as req'd) | | MK |
| 2 | Door Position Switch | By Security. | OT | |
| 1 | Power Supply | Provided by security | SU | |

Notes: Operation: Doors normally closed and locked. Valid card at the card reader retracts the latch on the active leaf for entry. Free egress at all times. Door status monitored. Confirm specified hardware is compatible with aluminum door manufacturer.

Set: 2.1

Doors: F1001A, G1001A, G1003A

Description: **Pr Ext - ASF - Exit Device- SN200/DT - KR Mullion - Closer w/Stop Arm -Access Control

| | | | | |
|---|---|----------------------------------|-----|----------|
| 1 | Continuous Hinge CFM SLF-HD1 x Dr. Ht. | | | PE |
| 1 | Continuous Hinge CFM SLF-HD1 PT x Dr. Ht. | | | PE |
| 1 | Electric Power Transfer | EL-CEPT | 630 | SU |
| 1 | Mullion | KR822 (FLK as req) | 600 | PR |
| 2 | Stabilizer | ST989 Dull Black | | PR |
| 1 | Spacer | MCS822 689 | | PR |
| 1 | Rim Exit x SPARNC-E11 | LD 19 TB 43 8510 862 | | US32D SA |
| 1 | Rim Exit x SPAR04867/NC-E11/NC-E35 | 19 LD TB 43 70 56-SN200-8504 862 | | US32D SA |
| 2 | Interchangeable Core | I/CK-7 626 | | BE |
| 1 | Rim Cylinder | 70 34 X #90 - 1/2 | | US32D SA |
| 1 | Const. Core | 7190224 Green | | BE |
| 2 | Door Closer | TB 351 PS | | EN SA |
| 2 | Kit | 581-1/ 581-2 as required | | EN SA |
| 2 | Sweep IDF/MDF/Alum | 18061CNB x Dr. Width | | PE |
| 1 | Threshold | 2005AT MSES25SS X Opening Width | | PE |
| 1 | Perimeter Seal | By door mfr | OT | |
| 1 | ElectroLynx Harness | QC-C1500P | | MK |
| 2 | ElectroLynx Harness | QC-C***P (length as req'd) | | MK |
| 2 | Door Position Switch | By Security. | OT | |
| 1 | Power Supply | Provided by security | SU | |

Notes: Operation: Doors normally closed and locked. Valid card at the card reader retracts the latch on the active leaf for entry. Free egress at all times. Door status monitored. Confirm specified hardware is compatible with aluminum door manufacturer.

Set: 3.0

Doors: G1017B, H131I, H131J, H171A, H171H

Description: **Sgl - ExT -HM - Exit- SN200 - Closer /Stop- Access Control

| | | | | |
|---|---------------------------------------|------------------------------|-----|----------|
| 1 | Continuous Hinge CFM HD1 PT x Dr. Ht. | | | PE |
| 1 | Electric Power Transfer | EL-CEPT | 630 | SU |
| 1 | Rim Exit x SPAR04867/NC-E11 | 19 LD TB 43 70 56-SN200-8804 | | US32D SA |
| 1 | Vandal Resistant Trim | 826 | | US32D SA |
| 1 | Interchangeable Core | I/CK-7 626 | | BE |
| 1 | Const. Core | 7190224 Green | | BE |
| 1 | Surface Closer | TB 351 PSH | | EN SA |
| 1 | Gasketing | 2891APK (head & jambs) | | PE |
| 1 | Rain Guard | 346C x Frame Width | | PE |
| 1 | Sweep | 345ANB x Dr. Width | | PE |

| | | | | | |
|---|----------------------|---------------------------------|----|----|----|
| 1 | Sweep IDF/MDF/Alum | 18061CNB x Dr. Width | | PE | |
| 1 | Threshold | 2005AT MSES25SS X Opening Width | | | PE |
| 1 | ElectroLynx Harness | QC-C1500P | MK | | |
| 1 | ElectroLynx Harness | QC-C***P (length as req'd) | | MK | |
| 1 | Door Position Switch | By Security. | OT | | |
| 1 | Power Supply | Provided by security | SU | | |

Notes: Operation: Doors normally closed and locked. Valid card at the card reader retracts the latch on the active leaf for entry. Free egress at all times. Door status monitored. Confirm specified hardware is compatible with door manufacturer.

Set: 4.0

Doors: H131G

Description: **Pr Ext - HM - Exit Device- SN200/DT - KR Mullion - Closer w/Stop Arm -Access Control

| | | | | | |
|---|---------------------------------------|---------------------------------|-------|-------|----|
| 2 | Continuous Hinge CFM HD1 x Dr. Ht. | | | PE | |
| 2 | Continuous Hinge CFM HD1 PT x Dr. Ht. | | | PE | |
| 1 | Electric Power Transfer | EL-CEPT | 630 | SU | |
| 1 | Mullion | KR822 (FLK as req) | 600 | PR | |
| 2 | Stabilizer | ST989 Dull Black | | PR | |
| 1 | Spacer | MCS822 689 | | PR | |
| 1 | Rim Exit x SPAR04867/NC-E11 | 19 LD TB 43 70 56-SN200-8804 | | US32D | SA |
| 1 | Rim Exit EO x SPAR#NC-E11 | 19 LD TB 43 8810 | | US32D | SA |
| 1 | Vandal Resistant Trim | 826 | | US32D | SA |
| 1 | Vandal Resistant Trim | 821 | | US32D | SA |
| 2 | Interchangeable Core | I/CK-7 | 626 | BE | |
| 1 | Rim Cylinder | 70 34 X #90 - 1/2 | | US32D | SA |
| 1 | Const. Core | 7190224 | Green | BE | |
| 2 | Door Closer | TB 351 PS | EN | SA | |
| 2 | Kit | 581-1/ 581-2 as required | EN | SA | |
| 1 | Astragal Set (2) | 18061CNB x Dr. Ht | | PE | |
| 1 | Gasketing | 2891APK (head & jambs) | | PE | |
| 2 | Sweep | 345ANB x Dr. Width | | PE | |
| 1 | Threshold | 2005AT MSES25SS X Opening Width | | | PE |
| 1 | ElectroLynx Harness | QC-C1500P | MK | | |
| 2 | ElectroLynx Harness | QC-C***P (length as req'd) | | MK | |
| 2 | Door Position Switch | By Security. | OT | | |
| 1 | Power Supply | Provided by security | SU | | |

Notes: Operation: Doors normally closed and locked. Valid card at the card reader retracts the latch on the active leaf for entry. Free egress at all times. Door status monitored.

Set: 5.0

Doors: G1016A, G1026A, X111

Description: **Sgl - Ext- Mech/Storage/Fire Riser - Closer w/Stop Arm

| | | | | | |
|---|------------------------------------|------------------------|-------|-------|----|
| 1 | Continuous Hinge CFM HD1 x Dr. Ht. | | | PE | |
| 1 | Storeroom/Closet Lock | 70 8204 LL | | US26D | SA |
| 1 | Interchangeable Core | I/CK-7 | 626 | BE | |
| 1 | Const. Core | 7190224 | Green | BE | |
| 1 | Door Closer | TB 351 PS | EN | SA | |
| 1 | Gasketing | 2891APK (head & jambs) | | PE | |
| 1 | Rain Guard | 346C x Frame Width | | PE | |

| | | | | |
|---|----------------------|---------------------------------|----|----|
| 1 | Sweep | 345ANB x Dr. Width | PE | |
| 1 | Threshold | 2005AT MSES25SS X Opening Width | | PE |
| 1 | Door Position Switch | By Security. | OT | |

Set: 5.1

Doors: G1019A

Description: **Pr - Ext- Rated SN200 Panic - Closer w/Stop Arm

| | | | | |
|---|--|---------------------------------|-------|----------|
| 2 | Continuous Hinge CFM SLF-HD1 x Dr. Ht. | | PE | |
| 2 | Continuous Hinge CFM HD1 PT x Dr. Ht. | | PE | |
| 1 | Electric Power Transfer | EL-CEPT | 630 | SU |
| 1 | Mullion | KR822 (FLK as req) | 600 | PR |
| 1 | Stabilizer | ST989 Dull Black | | PR |
| 1 | Spacer | MCS822 689 | | PR |
| 1 | Rim Exit SPAR04867/NC-E11 | 12 19 TB 43 70 56-SN200-8804 | | US32D SA |
| 1 | Rim Exit SPAR#NC-E11 | 12 19 TB 43 8810 EO | | US32D SA |
| 1 | Vandal Resistant Trim | 826 | | US32D SA |
| 1 | Vandal Resistant Trim | 821 | | US32D SA |
| 2 | Interchangeable Core | I/CK-7 | 626 | BE |
| 1 | Rim Cylinder | 70 34 X #90 - 1/2 | | US32D SA |
| 2 | Const. Core | 7190224 | Green | BE |
| 2 | Door Closer | TB 351 PS | EN | SA |
| 1 | Astragal Set (2) | 18061CNB x Dr. Ht | | PE |
| 1 | Gasketing | 2891APK (head & jambs) | | PE |
| 1 | Rain Guard | 346C x Frame Width | | PE |
| 2 | Sweep | 345ANB x Dr. Width | PE | |
| 1 | Threshold | 2005AT MSES25SS X Opening Width | | PE |
| 1 | ElectroLynx Harness | QC-C1500P | | MK |
| 1 | ElectroLynx Harness | QC-C***P (length as req'd) | | MK |
| 2 | Door Position Switch | By Security. | OT | |

Set: 5.2

Doors: X101

Description: **Sgl - Ext- Storage - Closer / Inswing

| | | | | |
|---|------------------------------------|--------------------------------|-------|----|
| 1 | Continuous Hinge CFM HD1 x Dr. Ht. | | PE | |
| 1 | Storeroom/Closet Lock | 70 8204 LL | US26D | SA |
| 1 | Interchangeable Core | I/CK-7 | 626 | BE |
| 1 | Const. Core | 7190224 | Green | BE |
| 1 | Door Closer | TB 351 O/P9 (type as required) | EN | SA |
| 1 | Door Stop | 481H | US26D | RO |
| 1 | Gasketing | 2891APK (head & jambs) | | PE |
| 1 | Rain Guard | 346C x Frame Width | | PE |
| 1 | Sweep | 345ANB x Dr. Width | PE | |
| 1 | Threshold | 171A | PE | |
| 1 | Door Position Switch | By Security. | OT | |

Set: 6.0

Doors: I137A, I137B

Description: **Pr Int- Rated Storeroom

| | | | | |
|---|------------------------------------|-------------------|-------|----|
| 1 | Continuous Hinge CFM HD1 x Dr. Ht. | | PE | |
| 1 | Surface Bolt | 580-12 @ top only | US26D | RO |
| 1 | Storeroom/Closet Lock | 70 8204 LL | US26D | SA |

| | | | |
|---|-----------------------------|----------------------------------|----------|
| 1 | Rim Exit x SPAR04867/NC-E11 | 12 19 TB 43 70 56-SN200-8804 ETL | US32D SA |
| 1 | Rim Exit DT x SPAR#NC-E11 | 12 19 TB 43 8810 ETL | US32D SA |
| 2 | Interchangeable Core | I/CK-7 626 BE | |
| 1 | Rim Cylinder | 70 34 X #90 - 1/2 US32D SA | |
| 2 | Const. Core | 7190224 Green BE | |
| 1 | Coordinator | 2672 Black RO | |
| 1 | Mounting Bracket | 2601AB Black RO | |
| 2 | Door Closer | TB 351 PS EN SA | |
| 2 | Kit | 581-1/ 581-2 as required EN SA | |
| 2 | Armor Plate | K1050 36" CSK BEV US32D RO | |
| 1 | Astragal Set (2) | 18061CNB x Dr. Ht PE | |
| 1 | Gasketing | 2891APK (head & jambs) PE | |
| 2 | Silencer 608 | RO | |
| 1 | ElectroLynx Harness | QC-C1500P MK | |
| 2 | ElectroLynx Harness | QC-C***P (length as req'd) MK | |
| 2 | Door Position Switch | By Security. OT | |
| 1 | Power Supply | Provided by security SU | |

Notes: Operation: Doors normally closed and locked. Valid card at the card reader retracts the latch on the active leaf for entry. Free egress at all times. Door status monitored. Confirm specified hardware is compatible with door manufacturer.

Set: 7.0

Description: **Pr Int- Rated Cordr 8816x8804 - Mullion - Closer - Armor

| | | |
|---|-------------------------------------|--|
| 2 | Continuous Hinge CFM HD1 x Dr. Ht. | PE |
| 1 | Mullion KR822 (FLK as req) 600 | PR |
| 2 | Stabilizer ST989 Dull Black | PR |
| 1 | Spacer MCS822 689 | PR |
| 1 | Rim Exit Rated Sec CR x SPAR#NC-E11 | 12 LD TB 19 43 49 70 8816 ETL US32D SA |
| 1 | Rim Exit SPAR NC-E11 | 12 LD 19 TB 43 70 8804 ETL US32D SA |
| 2 | Interchangeable Core | I/CK-7 626 BE |
| 1 | Rim Cylinder | 70 34 X #90 - 1/2 US32D SA |
| 2 | Const. Core | 7190224 Green BE |
| 2 | Door Closer | TB 351 PS EN SA |
| 2 | Kit | 581-1/ 581-2 as required EN SA |
| 2 | Armor Plate | K1050 36" CSK BEV US32D RO |
| 1 | Astragal Set (2) | 18061CNB x Dr. Ht PE |
| 1 | Gasketing | 2891APK (head & jambs) PE |

Notes: Operation: Doors normally closed and locked. Valid card at the card reader retracts the latch on the active leaf for entry. Free egress at all times. Door status monitored. Confirm specified hardware is compatible with door manufacturer.

Set: 7.1

Doors: C1071

Description: **Pr Int- Rated Stair 8815 - Mullion - Closer

| | | |
|---|--------------------------------------|-------------------------------|
| 2 | Continuous Hinge CFM HD1 x Dr. Ht. | PE |
| 1 | Mullion KR822 (FLK as req) 600 | PR |
| 2 | Stabilizer ST989 Dull Black | PR |
| 1 | Spacer MCS822 689 | PR |
| 2 | Rim Exit Device, Passage SPAR#NC-E11 | 12 19 TB 43 8815 ETL US32D SA |

| | | | | | |
|---|----------------------|--------------------------|-------|----|--|
| 1 | Interchangeable Core | I/CK-7 | 626 | BE | |
| 1 | Rim Cylinder | 70 34 X #90 - 1/2 | US32D | SA | |
| 1 | Const. Core | 7190224 | Green | BE | |
| 2 | Door Closer | TB 351 PS | EN | SA | |
| 2 | Kit | 581-1/ 581-2 as required | EN | SA | |
| 2 | Armor Plate | K1050 36" CSK BEV | US32D | RO | |
| 1 | Astragal Set (2) | 18061CNB x Dr. Ht | | PE | |
| 1 | Gasketing | 2891APK (head & jambs) | | PE | |

Notes: Operation: Doors normally closed and locked. Valid card at the card reader retracts the latch on the active leaf for entry. Free egress at all times. Door status monitored. Confirm specified hardware is compatible with door manufacturer.

Set: 8.0

Doors: G1008B

Description: **Sgl - Exit Device-Security CL - Closer / HO

| | | | | | |
|---|-------------------------------|-------------------------------|-------|----|--|
| 3 | Hinge (heavy weight) | T4A3786 | US26D | MK | |
| 1 | Rim Exit Sec CR x SPAR#NC-E11 | LD 19 LD TB 43 49 70 8816 ETL | US32D | SA | |
| 2 | Interchangeable Core | I/CK-7 | 626 | BE | |
| 2 | Const. Core | 7190224 | Green | BE | |
| 1 | Surface Closer | TB 351 PSH | EN | SA | |
| 1 | Door Stop | 481H | US26D | RO | |
| 3 | Silencer 608 | RO | | | |

Notes: Provide hold open closers at classrooms.

Set: 9.0

Doors: H161A, J171A

Description: **Sgl - Rated Exit Device-Security CL - Closer

| | | | | | |
|---|-------------------------------------|-------------------------------|-------|----|--|
| 3 | Hinge (heavy weight) | T4A3786 | US26D | MK | |
| 1 | Rim Exit Rated Sec CR x SPAR#NC-E11 | 12 LD TB 19 43 49 70 8816 ETL | US32D | SA | |
| 2 | Interchangeable Core | I/CK-7 | 626 | BE | |
| 2 | Const. Core | 7190224 | Green | BE | |
| 1 | Door Closer | TB 351 PS | EN | SA | |
| 1 | Door Stop | 481H | US26D | RO | |
| 1 | Gasketing | 2891APK (head & jambs) | | PE | |

Notes: Provide hold open closers at non-rated classrooms.

Set: 10.0

Doors: G1011A, G1017A

Description: **Sgl - ASF Exit Device-Security CL - Closer / HO

| | | | | | |
|---|-------------------------------|-------------------------------|-------|----|--|
| 3 | Hinge, Full Mortise | TA2714 | US26D | MK | |
| 1 | Rim Exit Sec CR x SPAR#NC-E11 | LD 19 LD TB 43 49 70 8816 ETL | US32D | SA | |
| 2 | Interchangeable Core | I/CK-7 | 626 | BE | |
| 2 | Const. Core | 7190224 | Green | BE | |
| 1 | Surface Closer | TB 351 PSH | EN | SA | |
| 1 | Door Stop | 481H | US26D | RO | |
| 1 | Gasketing / silencer | By the frame manufacturer | | OT | |

Notes: Provide hold open closers at classrooms.

Set: 11.0

Doors: C103, C115, G135A

Description: **Sgl - Rated Exit Device-Security CL - Closer - STC

| | | | | | | | | |
|---|---|--------------------------|--|--------------------------|--|--|--|----|
| 3 | Hinges | By the door manufacturer | | OT | | | | |
| 1 | STC Rim Exit Rated Sec CR x SPAR#NC-E11 | | 12 LD TB 19 31 43 49 70 8816 ETL US32D | | | | | SA |
| 2 | Interchangeable Core | I/CK-7 | 626 | BE | | | | |
| 2 | Const. Core | 7190224 | Green | BE | | | | |
| 1 | Door Closer | TB 351 PS | EN | SA | | | | |
| 1 | Sex Nut & Bolt Kit | SNB134-38 | 689 | NO | | | | |
| 1 | Door Stop | 462 US2C | RO | | | | | |
| 1 | Gasketing, door bottom and threshold | | | By STC door manufacturer | | | | OT |

Notes: Provide hold open closers at non-rated classrooms. Sex Nut & Bolt Kit to be used to fill existing pull prep

Set: 12.0

Doors: G1002A, G1002B, G111B

Description: **Sgl - Exit Device-NL - Closer - STC

| | | | | | | | | |
|---|--------------------------------------|--------------------------|----------------------------|--------------------------|--|-------|--|----|
| 3 | Hinges | By the door manufacturer | | OT | | | | |
| 1 | Rim Exit NL SPAR#NC-E11 | | LD 19 TB 31 43 70 8804 ETL | | | US32D | | SA |
| 1 | Interchangeable Core | I/CK-7 | 626 | BE | | | | |
| 1 | Const. Core | 7190224 | Green | BE | | | | |
| 1 | Door Closer | TB 351 PS | EN | SA | | | | |
| 1 | Door Stop | 481H US26D | RO | | | | | |
| 1 | Gasketing, door bottom and threshold | | | By STC door manufacturer | | | | OT |

Notes: Provide hold open closers at non-rated classrooms.

Set: 12.1

Doors: C107G

Description: **Sgl - Exit Device-NL - Closer

| | | | | | | | | |
|---|-------------------------|------------------------|-------------------------------|-------|----|----|--|----|
| 3 | Hinge (heavy weight) | T4A3786 | | US26D | MK | | | |
| 1 | Rim Exit NL SPAR#NC-E11 | | LD 19 TB 43 70 8804 ETL US32D | | | SA | | |
| 1 | Interchangeable Core | I/CK-7 | 626 | BE | | | | |
| 1 | Const. Core | 7190224 | Green | BE | | | | |
| 1 | Door Closer | TB 351 PS | EN | SA | | | | |
| 1 | Door Stop | 481H US26D | RO | | | | | |
| 1 | Gasketing | 2891APK (head & jambs) | | | | | | PE |

Set: 13.0

Doors: G1004A

Description: **Pr - Gym Sec CL x NL -HO Closer

| | | | | | | | | |
|---|-------------------------------|--------------------|-------------------------------|-------|----|-------|--|----|
| 6 | Hinge (heavy weight) | T4A3786 | | US26D | MK | | | |
| 1 | Mullion | KR822 (FLK as req) | 600 | PR | | | | |
| 2 | Stabilizer | ST989 Dull Black | | PR | | | | |
| 1 | Spacer | MCS822 689 | PR | | | | | |
| 1 | Rim Exit Sec CR x SPAR#NC-E11 | | LD 19 LD TB 43 49 70 8816 ETL | | | US32D | | SA |
| 1 | Rim Exit NL SPAR#NC-E11 | | LD 19 TB 43 70 8804 ETL US32D | | | SA | | |
| 4 | Interchangeable Core | I/CK-7 | 626 | BE | | | | |

| | | | | | |
|---|-------------------|---------------|------------------------------------|--------|-------|
| 1 | Mullion Cylinder | 70 34 x 1KB-3 | US32D | SA | |
| 4 | Const. Core | 7190224 | Green | BE | |
| 2 | Door Closer w/ HO | | TB 351 H (inswing)/ PSH (outswing) | As Req | EN SA |
| 2 | Door Stop | 481H | US26D | RO | |
| 2 | Silencer 608 | | RO | | |

Notes: Provide hold open closers at non-rated openings - MHO at rated.

Set: 14.0

Doors: G1023A, G106A, H156B, H157A

Description: **Sgl - Storeroom

| | | | | | |
|---|-----------------------|---------|-------|-------|----|
| 3 | Hinge, Full Mortise | TA2714 | US26D | MK | |
| 1 | Storeroom/Closet Lock | 70 8204 | LL | US26D | SA |
| 1 | Interchangeable Core | I/CK-7 | 626 | BE | |
| 1 | Const. Core | 7190224 | Green | BE | |
| 1 | Door Stop | 481H | US26D | RO | |
| 3 | Silencer 608 | | RO | | |

Set: 15.0

Doors: C107F

Description: **Sgl - Storeroom - Closer - Armor - Gasket

| | | | | | |
|---|-----------------------|------------------------|-------------------------|-------|----|
| 3 | Hinge, Full Mortise | TA2714 | US26D | MK | |
| 1 | Storeroom/Closet Lock | 70 8204 | LL | US26D | SA |
| 1 | Interchangeable Core | I/CK-7 | 626 | BE | |
| 1 | Const. Core | 7190224 | Green | BE | |
| 1 | Door Closer | TB 351 | O/P9 (type as required) | EN | SA |
| 1 | Armor Plate | K1050 36" | CSK BEV | US32D | RO |
| 1 | Door Stop | 481H | US26D | RO | |
| 1 | Gasketing | 2891APK (head & jambs) | | PE | |

Set: 16.0

Doors: A103A

Description: **Sgl - EX FR Storeroom - Closer - Continuous Hinge

| | | | | | |
|---|---------------------------------------|------------------------|-------------------------|-------|----|
| 1 | Continuous Hinge CFM HD1 PT x Dr. Ht. | | | | PE |
| 1 | Storeroom/Closet Lock | 70 8204 | LL | US26D | SA |
| 1 | Interchangeable Core | I/CK-7 | 626 | BE | |
| 1 | Const. Core | 7190224 | Green | BE | |
| 1 | Door Closer | TB 351 | O/P9 (type as required) | EN | SA |
| 1 | Door Stop | 481H | US26D | RO | |
| 1 | Gasketing | 2891APK (head & jambs) | | PE | |
| 3 | Silencer 608 | | RO | | |

Set: 17.0

Doors: C107B, C107E, G1012A, H172A, H172B, H173A

Description: **Sgl - Storeroom - Closer /Stop - Gasket

| | | | | | |
|---|-----------------------|---------|-------|-------|----|
| 3 | Hinge, Full Mortise | TA2714 | US26D | MK | |
| 1 | Storeroom/Closet Lock | 70 8204 | LL | US26D | SA |
| 1 | Interchangeable Core | I/CK-7 | 626 | BE | |
| 1 | Const. Core | 7190224 | Green | BE | |
| 1 | Door Closer | TB 351 | PS | EN | SA |

1 Gasketing 2891APK (head & jambs) PE

Set: 17.1

Doors: H159A

Description: **Sgl - Storeroom - Closer Wide

3 Hinge (heavy weight) T4A3786 US26D MK
 1 Storeroom/Closet Lock 70 8204 LL US26D SA
 1 Interchangeable Core I/CK-7 626 BE
 1 Const. Core 7190224 Green BE
 1 Door Closer TB 351 O/P9 (type as required) EN SA
 1 Door Stop 481H US26D RO
 3 Silencer 608 RO

Set: 18.0

Doors: F1002A, G1005A

Description: **Pr - Storeroom - Floor Stop - No Closer

6 Hinge, Full Mortise TA2714 US26D MK
 1 Surface Bolt 580-12 @ top only US26D RO
 1 Storeroom/Closet Lock 70 8204 LL US26D SA
 1 Interchangeable Core I/CK-7 626 BE
 1 Const. Core 7190224 Green BE
 2 Door Stop 481H US26D RO
 2 Silencer 608 RO

Set: 19.0

Doors: C107C

Description: **Pr - Rated Storeroom - Floor Stop - Mechanical - Closer

6 Hinge, Full Mortise TA2714 US26D MK
 1 Continuous Latch Flush Bolt 2805 /2905 US26D RO
 1 Storeroom/Closet Lock 70 8204 LL US26D SA
 1 Interchangeable Core I/CK-7 626 BE
 1 Const. Core 7190224 Green BE
 1 Coordinator 2672 Black RO
 1 Mounting Bracket 2601AB Black RO
 2 Door Closer TB 351 PS EN SA
 2 Door Stop 481H US26D RO
 1 Astragal Set (2) 18061CNC x Dr. Ht PE
 1 Gasketing 2891APK (head & jambs) PE

Set: 20.0

Doors: C113, D216A, G1015A, G125A

Description: **Sgl - Office, Conf, Work, Sat Admin Offices, Lounge, Nurse - No Closer

3 Hinge, Full Mortise TA2714 US26D MK
 1 Classroom Lock 70 8237 LL US26D SA
 1 Interchangeable Core I/CK-7 626 BE
 1 Const. Core 7190224 Green BE
 1 Door Stop 481H US26D RO
 3 Silencer 608 RO

Set: 21.0

Doors: C107D

Description: **Sgl - Rated Office, Conf, Work, Sat Admin Offices, Lounge, Nurse - Closer

| | | | | | | |
|---|----------------------|--------------------------------|-------|----|----|----|
| 3 | Hinge, Full Mortise | TA2714 | US26D | MK | | |
| 1 | Classroom Lock | 70 8237 LL | US26D | SA | | |
| 1 | Interchangeable Core | I/CK-7 626 | BE | | | |
| 1 | Const. Core | 7190224 | Green | BE | | |
| 1 | Door Closer | TB 351 O/P9 (type as required) | | | EN | SA |
| 1 | Door Stop | 481H | US26D | RO | | |
| 1 | Gasketing | 2891APK (head & jambs) | | | PE | |

Set: 22.0

Doors: G1009A

Description: **Sgl - Office, Conf, Work, Sat Admin Offices, Lounge, Nurse - Closer

| | | | | | | |
|---|----------------------|---|-------|----|----|----|
| 3 | Hinge, Full Mortise | TA2714 | US26D | MK | | |
| 1 | Classroom Lock | 70 8237 LL | US26D | SA | | |
| 1 | Interchangeable Core | I/CK-7 626 | BE | | | |
| 1 | Const. Core | 7190224 | Green | BE | | |
| 1 | Door Closer w/ HO | TB 351 H (inswing)/ PSH (outswing) As Req | | | EN | SA |
| 1 | Door Stop | 481H | US26D | RO | | |
| 1 | Gasketing | 2891APK (head & jambs) | | | PE | |

Set: 23.0

Doors: G1010A

Description: **Sgl - ASF Office Closer

| | | | | | | |
|---|----------------------|---|-------|----|----|----|
| 3 | Hinge, Full Mortise | TA2714 | US26D | MK | | |
| 1 | Classroom Lock | 70 8237 LL | US26D | SA | | |
| 1 | Interchangeable Core | I/CK-7 626 | BE | | | |
| 1 | Const. Core | 7190224 | Green | BE | | |
| 1 | Door Closer w/ HO | TB 351 H (inswing)/ PSH (outswing) As Req | | | EN | SA |
| 1 | Door Stop | 481H | US26D | RO | | |
| 1 | Gasketing | By the frame manufacturer | | | OT | |

Set: 23.1

Doors: G1014A

Description: **Sgl - ASF Storeroom Closer

| | | | | | | |
|---|-----------------------|--------------------------------|-------|----|----|----|
| 3 | Hinge, Full Mortise | TA2714 | US26D | MK | | |
| 1 | Storeroom/Closet Lock | 70 8204 LL | US26D | SA | | |
| 1 | Interchangeable Core | I/CK-7 626 | BE | | | |
| 1 | Const. Core | 7190224 | Green | BE | | |
| 1 | Door Closer | TB 351 O/P9 (type as required) | | | EN | SA |
| 1 | Door Stop | 481H | US26D | RO | | |
| 1 | Gasketing | By the frame manufacturer | | | OT | |

Set: 24.0

Doors: C106, C108-1, C111, C112, C119, C120, C121, G1018A, G1021A, G1022A, G1024A, G119A, G121A, G122A, G123A, G124A

Description: **Sgl - Practice - Classroom - Closer - STC

| | | | | | | |
|---|----------------------|--------------------------|-------|----|----|--|
| 3 | Hinges | By the door manufacturer | | | OT | |
| 1 | Classroom Lock | 31 70 8237 LL | US26D | SA | | |
| 1 | Interchangeable Core | I/CK-7 626 | BE | | | |
| 1 | Const. Core | 7190224 | Green | BE | | |

| | | | | | |
|---|--------------------------------------|--------------------------------|----|----|----|
| 1 | Door Closer | TB 351 O/P9 (type as required) | EN | SA | |
| 1 | Door Stop | 462 US2C | RO | | |
| 1 | Gasketing, door bottom and threshold | By STC door manufacturer | | | OT |

Set: 24.1

Doors: C107H

Description: **Sgl Typ - Security Classroom - Closer - HO

| | | | | | |
|---|----------------------------------|--|-------|----|--|
| 3 | Hinge, Full Mortise | TA2714 | US26D | MK | |
| 1 | Classroom Security Intruder Lock | V01 EMB 70 8238 VN1L 90-3/8" Collar | US26D | SA | |
| 2 | Interchangeable Core | I/CK-7 626 | BE | | |
| 2 | Const. Core | 7190224 | Green | BE | |
| 1 | Door Closer w/ HO | TB 351 H (inswing)/ CPSH (outswing) As Req | EN | SA | |
| 1 | Kit | 581-1/ 581-2 as required | EN | SA | |
| 1 | Door Stop | 481H | US26D | RO | |
| 3 | Silencer 608 | RO | | | |

Notes: Provide hold open closers at classrooms.

Set: 24.2

Doors: H155A

Description: **Sgl Typ - Security Classroom - Closer - HO - Wide

| | | | | | |
|---|----------------------------------|--|-------|----|--|
| 3 | Hinge (heavy weight) | T4A3786 | US26D | MK | |
| 1 | Classroom Security Intruder Lock | V01 EMB 70 8238 VN1L 90-3/8" Collar | US26D | SA | |
| 2 | Interchangeable Core | I/CK-7 626 | BE | | |
| 2 | Const. Core | 7190224 | Green | BE | |
| 1 | Door Closer w/ HO | TB 351 H (inswing)/ CPSH (outswing) As Req | EN | SA | |
| 1 | Kit | 581-1/ 581-2 as required | EN | SA | |
| 1 | Door Stop | 481H | US26D | RO | |
| 3 | Silencer 608 | RO | | | |

Notes: Provide hold open closers at classrooms.

Set: 24.3

Doors: H158A

Description: **Sgl Classroom

| | | | | | |
|---|----------------------|------------|-------|----|--|
| 3 | Hinge, Full Mortise | TA2714 | US26D | MK | |
| 1 | Classroom Lock | 70 8237 LL | US26D | SA | |
| 1 | Interchangeable Core | I/CK-7 626 | BE | | |
| 1 | Const. Core | 7190224 | Green | BE | |
| 1 | Door Stop | 481H | US26D | RO | |
| 3 | Silencer 608 | RO | | | |

Notes: Provide hold open closers at classrooms.

Set: 25.0

Doors: C239A, C241A, D229A, D231A

Description: **Sgl - MS / HS Staff RR - Hotel Lock w/Indicator - Closer / HO

| | | | | | |
|---|-----------------------|------------------|-------|----|--|
| 3 | Hinge, Full Mortise | TA2714 | US26D | MK | |
| 1 | Hotel Guest Lock Lock | V20 LC 8250 VN1L | US26D | SA | |
| 1 | Interchangeable Core | I/CK-7 626 | BE | | |
| 1 | Const. Core | 7190224 | Green | BE | |

| | | | | | |
|---|---------------------------------|---|-----|----|----|
| 1 | Mortise Cylinder for Hotel Lock | 1E-7G4 C208 RP3 | 626 | BE | |
| 1 | Door Closer w/ HO | TB 351 H (inswing)/ PSH (outswing) As Req | EN | | SA |
| 1 | Kit | 581-1/ 581-2 as required | EN | SA | |
| 1 | Door Stop | 481H US26D | RO | | |
| 1 | Gasketing | 2891APK (head & jambs) | | PE | |

Set: 26.0

Description: Not Used

| | | | | | |
|---|-----|----------|--|----|--|
| 1 | Set | Not Used | | OT | |
|---|-----|----------|--|----|--|

Set: 27.0

Description: Not Used

| | | | | | |
|---|-----|----------|--|----|--|
| 1 | Set | Not Used | | OT | |
|---|-----|----------|--|----|--|

Set: 28.0

Doors: G1008A

Description: Sgl - Push Pull - Closer - HO

| | | | | | |
|---|---------------------|---|----|--|----|
| 3 | Hinge, Full Mortise | TA2714 US26D | MK | | |
| 1 | Push Plate | 70E US32D | RO | | |
| 1 | Pull Plate | 111x70CUS32D | RO | | |
| 1 | Door Closer w/ HO | TB 351 H (inswing)/ PSH (outswing) As Req | EN | | SA |
| 1 | Door Stop | 481H US26D | RO | | |
| 3 | Silencer 608 | | RO | | |

Set: 29.0

Doors: G1004B

Description: Pr - Push Pull - Closer - HO

| | | | | | |
|---|---------------------|---|----|----|----|
| 6 | Hinge, Full Mortise | TA2714 US26D | MK | | |
| 2 | Push Plate | 70E US32D | RO | | |
| 2 | Pull Plate | 111x70CUS32D | RO | | |
| 2 | Door Closer w/ HO | TB 351 H (inswing)/ PSH (outswing) As Req | EN | | SA |
| 2 | Door Stop | 481H US26D | RO | | |
| 1 | Astragal Set (2) | 18061CNCB x Dr. Ht | | PE | |
| 1 | Gasketing | 2891APK (head & jambs) | | PE | |

Set: 30.0

Doors: B105, B107, H153A, H154A, I125A, J102A, J105A

Description: **Sgl - Multi Occ RR - Classroom Cyl - Closer

| | | | | | |
|---|----------------------|---|----|----|----|
| 3 | Hinge, Full Mortise | TA2714 US26D | MK | | |
| 1 | Classroom Lock | 70 10XG37 LL US26D | SA | | |
| 1 | Interchangeable Core | I/CK-7 626 | BE | | |
| 1 | Const. Core | 7190224 Green | BE | | |
| 1 | Door Closer w/ HO | TB 351 H (inswing)/ PSH (outswing) As Req | EN | | SA |
| 1 | Door Stop | 481H US26D | RO | | |
| 1 | Gasketing | 2891APK (head & jambs) | | PE | |

Set: 31.0

Doors: F117A, H131C, H131D, H138A

Description: **Sgl - Rated - Multi Occ RR - Classroom Cyl - Closer

| | | | | | | |
|---|----------------------|--------------------------------|-------|----|----|----|
| 3 | Hinge, Full Mortise | TA2714 | US26D | MK | | |
| 1 | Classroom Lock | 70 10XG37 LL | US26D | SA | | |
| 1 | Interchangeable Core | I/CK-7 | 626 | BE | | |
| 1 | Const. Core | 7190224 | Green | BE | | |
| 1 | Door Closer | TB 351 O/P9 (type as required) | | | EN | SA |
| 1 | Door Stop | 481H | US26D | RO | | |
| 1 | Gasketing | 2891APK (head & jambs) | | | PE | |

Set: 32.0

Doors: C137B, D102A, D184A, E131B, E164C

Description: Add Reader - Mullion

| | | | | | | |
|---|----------------------|-----------------------|------------|----|----|--|
| 1 | Mullion | KR822 (FLK as req) | 600 | PR | | |
| 2 | Stabilizer | ST989 | Dull Black | PR | | |
| 1 | Spacer | MCS822689 | PR | | | |
| 1 | Interchangeable Core | I/CK-7 | 626 | BE | | |
| 1 | Mullion Cylinder | 70 34 x 1KB-3 | US32D | SA | | |
| 1 | Const. Core | 7190224 | Green | BE | | |
| 1 | SN200 Reader | 52 6027 (Exit / Lock) | 26D | | SA | |
| 1 | Balance of hardware | Existing to remain | | | OT | |

Notes:

*Replace HID reader on wall with SN200 reader.

Set: 32.1

Doors: 1506A, C139

Description: Add Reader

| | | | | | | |
|---|---------------------|-----------------------|-----|--|----|--|
| 1 | SN200 Reader | 52 6027 (Exit / Lock) | 26D | | SA | |
| 1 | Balance of hardware | Existing to remain | | | OT | |

Notes:

*Replace HID reader on wall with SN200 reader.

Set: 33.0

Doors: J129A

Description: Add Reader - Mullion - Sweeps

| | | | | | | |
|---|----------------------|-----------------------|------------|----|----|--|
| 1 | Mullion | KR822 (FLK as req) | 600 | PR | | |
| 2 | Stabilizer | ST989 | Dull Black | PR | | |
| 1 | Spacer | MCS822689 | PR | | | |
| 1 | Interchangeable Core | I/CK-7 | 626 | BE | | |
| 1 | Mullion Cylinder | 70 34 x 1KB-3 | US32D | SA | | |
| 1 | Const. Core | 7190224 | Green | BE | | |
| 2 | Sweep | 345ANB x Dr. Width | | PE | | |
| 1 | SN200 Reader | 52 6027 (Exit / Lock) | 26D | | SA | |
| 1 | Balance of hardware | Existing to remain | | | OT | |

Notes:

*Replace HID reader on wall with SN200 reader.

Set: 34.0

Doors: E131C

Description: Add SN200 8500 - EPT

| | | | | | | |
|---|-----------------------------------|----------------------------|------------------------------|----|-------|----|
| 1 | Electric Power Transfer | EL-CEPT | 630 | SU | | |
| 1 | Rim Exit xSPAR04867/NC-E11/NC-E35 | | 19 LD TB 43 70 56-SN200-8504 | | US32D | SA |
| 1 | Interchangeable Core | I/CK-7 | 626 | BE | | |
| 1 | Const. Core | 7190224 | Green | BE | | |
| 1 | ElectroLynx Harness | QC-C1500P | | | MK | |
| 1 | ElectroLynx Harness | QC-C***P (length as req'd) | | | MK | |
| 1 | Door Position Switch | By Security. | | | OT | |
| 1 | Power Supply | Provided by security | | | SU | |
| 1 | Balance of hardware | Existing to remain | | | OT | |

Notes: Remove cylinder dogging on existing rail with 68-1375 mounting rail insert. Reuse existing trim.

Set: 35.0

Doors: B101-1A, B101-2, C137A, D192B, F106A

Description: Add Mullion

| | | | | | | |
|---|----------------------|--------------------|------------|-------|----|--|
| 1 | Mullion | KR822 (FLK as req) | 600 | PR | | |
| 2 | Stabilizer | ST989 | Dull Black | PR | | |
| 1 | Spacer | MCS822689 | | PR | | |
| 1 | Interchangeable Core | I/CK-7 | 626 | BE | | |
| 1 | Mullion Cylinder | 70 34 x 1KB-3 | | US32D | SA | |
| 1 | Const. Core | 7190224 | Green | BE | | |

Set: 36.0

Doors: B103A

Description: Add HO closer

| | | | | | | |
|---|---------------------|---|----|----|----|--|
| 1 | Door Closer w/ HO | TB 351 H (inswing)/ PSH (outswing) As Req | EN | SA | | |
| 1 | Balance of hardware | Existing to remain | | | OT | |

Set: 37.0

Doors: J132A, J132B

Description: Add closers (2)

| | | | | | | |
|---|---------------------|--------------------|----|----|----|--|
| 2 | Door Closer | TB 351 PS | EN | SA | | |
| 1 | Balance of hardware | Existing to remain | | | OT | |

Set: 38.0

Doors: I120A

Description: Add Exit Device-8816- HO Closers

| | | | | | | |
|---|-------------------------------|--------------------|----------------------------|----|-------|----|
| 1 | Rim Exit Sec CR x SPAR#NC-E11 | | 19 LD TB 43 49 70 8816 ETL | | US32D | SA |
| 2 | Interchangeable Core | I/CK-7 | 626 | BE | | |
| 2 | Const. Core | 7190224 | Green | BE | | |
| 1 | Surface Closer | TB 351 PSH | | EN | SA | |
| 1 | Door Stop | 481H | US26D | RO | | |
| 1 | Balance of hardware | Existing to remain | | | OT | |

Notes: Provide hold open closers at classrooms unless fire rated. No hold open on rated doors.

Set: 39.0

Doors: A105-2, A108-2, A109-2, A113-2, A210-2, A212-2, A215-2, B101B, B102B, J117A, J128A, J173A
 Description: Add Rated Exit Device-8816

| | | | |
|---|-------------------------------------|-------------------------------|----------|
| 1 | Rim Exit Rated Sec CR x SPAR#NC-E11 | 12 LD TB 19 43 49 70 8816 ETL | US32D SA |
| 2 | Interchangeable Core I/CK-7 | 626 BE | |
| 2 | Const. Core 7190224 | Green BE | |
| 1 | Door Closer TB 351 PS | EN SA | |
| 1 | Door Stop 481H | US26D RO | |
| 1 | Balance of hardware | Existing to remain | OT |

Notes: Provide hold open closers at classrooms unless fire rated. No hold open on rated doors.

Set: 40.0

Doors: D221A, D221C
 Description: Add Exit Device-8816/8804- Mullion

| | | | |
|---|--------------------------------|----------------------------|----------|
| 1 | Mullion KR822 (FLK as req) | 600 PR | |
| 2 | Stabilizer ST989 | Dull Black PR | |
| 1 | Spacer MCS822689 | PR | |
| 1 | Rim Exit Sec CR x SPAR#NC-E11 | 19 LD TB 43 49 70 8816 ETL | US32D SA |
| 1 | Rim Exit NL SPAR#NC-E11 | LD 19 TB 43 70 8804 ETL | US32D SA |
| 3 | Interchangeable Core I/CK-7 | 626 BE | |
| 1 | Mullion Cylinder 70 34 x 1KB-3 | US32D SA | |
| 3 | Const. Core 7190224 | Green BE | |
| 2 | Door Stop 481H | US26D RO | |
| 1 | Balance of hardware | Existing to remain | OT |

Notes: Provide hold open closers at classrooms unless fire rated. No hold open on rated doors.
 **TB Kit to be used to fill existing pull preps.

Set: 41.0

Doors: A101A, A101B, A101C, B106, D228B, J107A, J107B, J107C, J107D, J107E, J107F, J107G, J155A, J155B
 Description: Add Rated Exit Device-8816/8804- Mullion

| | | | |
|---|-------------------------------------|-------------------------------|----------|
| 1 | Mullion KR822 (FLK as req) | 600 PR | |
| 2 | Stabilizer ST989 | Dull Black PR | |
| 1 | Spacer MCS822689 | PR | |
| 1 | Rim Exit Rated Sec CR x SPAR#NC-E11 | 12 LD TB 19 43 49 70 8816 ETL | US32D SA |
| 1 | Rim Exit SPAR NC-E11 | 12 LD 19 TB 43 70 8804 ETL | US32D SA |
| 4 | Interchangeable Core I/CK-7 | 626 BE | |
| 1 | Mullion Cylinder 70 34 x 1KB-3 | US32D SA | |
| 4 | Const. Core 7190224 | Green BE | |
| 2 | Door Stop 481H | US26D RO | |
| 1 | Balance of hardware | Existing to remain | OT |

Notes: Provide hold open closers at classrooms unless fire rated. No hold open on rated doors.
 **TB Kit to be used to fill existing pull preps.

Set: 42.0

Doors: F119A, F119B

Description: Add Rated 8816 x 704 ETL

| | | | | |
|---|-------------------------------------|-------------------------------|-------|----|
| 1 | Rim Exit Rated Sec CR x SPAR#NC-E11 | 12 LD TB 19 43 49 70 8816 ETL | US32D | SA |
| 1 | Exit Device Trim 70 704ETL LHR | US26D | SA | |
| 3 | Interchangeable Core I/CK-7 | 626 | BE | |
| 3 | Const. Core 7190224 | Green | BE | |
| 1 | Balance of hardware | Existing to remain | | OT |

Notes: RHR 8816

LHR 70-704

Set: 43.0

Doors: D187A, J171B, J173B

Description: 70 704 ETL

| | | | | |
|---|--------------------------------|--------------------|----|----|
| 1 | Exit Device Trim 70 704ETL LHR | US26D | SA | |
| 1 | Interchangeable Core I/CK-7 | 626 | BE | |
| 1 | Const. Core 7190224 | Green | BE | |
| 1 | Balance of hardware | Existing to remain | | OT |

Set: 44.0

Doors: G111A

Description: Add Rated 8816 - STC door bottom, gasket, SNB

| | | | | |
|---|---|----------------------------------|-------|----|
| 1 | STC Rim Exit Rated Sec CR x SPAR#NC-E11 | 12 LD TB 19 31 43 49 70 8816 ETL | US32D | SA |
| 3 | Interchangeable Core I/CK-7 | 626 | BE | |
| 3 | Const. Core 7190224 | Green | BE | |
| 1 | Sex Nut & Bolt Kit SNB134-38 | 689 | NO | |
| 1 | Door Stop 462 | US2C | RO | |
| 1 | Gasketing 2891APK (head & jambs) | | | PE |
| 1 | Door Bottom STC411APK | | | PE |
| 1 | Balance of hardware | Existing to remain | | OT |

Notes: TB used to fill exiting pull prep

Set: 45.0

Doors: A105-1, A108-1, A109-1, A113-1, A210-1, A212-1, A215-1, B101A, B102A, D228A, F113A, J117B, J128B

Description: Add Rated Exit Device-8804

| | | | | |
|---|-----------------------------|----------------------------|-------|----|
| 1 | Rim Exit SPAR NC-E11 | 12 LD 19 TB 43 70 8804 ETL | US32D | SA |
| 1 | Interchangeable Core I/CK-7 | 626 | BE | |
| 1 | Const. Core 7190224 | Green | BE | |
| 1 | Door Closer TB 351 PS | EN | SA | |
| 1 | Door Stop 481H | US26D | RO | |
| 1 | Balance of hardware | Existing to remain | | OT |

Notes: Provide hold open closers at classrooms unless fire rated. No hold open on rated doors.

Set: 46.0

Doors: C101A, I116A

Description: Add SN200 Narrow Exit 8504 x 8510, EPT - Pivots

| | | | | | | | |
|---|-------------------------|------------------------------|------------------|---------------------------|-------|-------|----|
| 2 | Pivots | New - by Storefront Supplier | | | OT | | |
| 1 | Electric Power Transfer | EL-CEPT | 630 | | SU | | |
| 1 | Mullion | KR822 (FLK as req) | 600 | | PR | | |
| 2 | Stabilizer | ST989 Dull Black | | | PR | | |
| 1 | Spacer | MCS822689 | | | PR | | |
| 1 | Rim Exit | xSPAR04867/NC-E11/NC-E35 | 19 | LD TB 43 70 56-SN200-8504 | | US32D | SA |
| 1 | Rim Exit | SPAR NC-E11 | LD 19 TB 43 8510 | EO | | US32D | SA |
| 2 | Interchangeable Core | I/CK-7 | 626 | | BE | | |
| 1 | Mullion Cylinder | 70 34 x 1KB-3 | | | US32D | SA | |
| 2 | Const. Core | 7190224 | Green | | BE | | |
| 1 | ElectroLynx Harness | QC-C1500P | | | | MK | |
| 2 | ElectroLynx Harness | QC-C***P (length as req'd) | | | | | MK |
| 1 | Power Supply | Provided by security | | | | SU | |
| 1 | Balance of hardware | Existing to remain | | | | | OT |

Notes: Doors are normally closed and secure. Presentation of valid credential will allow entry by pull. Upon loss of power, doors will remain secure. Free egress at all times.

Set: 47.0

Doors: F101A, I101A, I116D

Description: Add SN200 Narrow Exit 8504 x 8510, EPT

| | | | | | | | |
|---|-------------------------|----------------------------|------------------|---------------------------|-------|-------|----|
| 1 | Electric Power Transfer | EL-CEPT | 630 | | SU | | |
| 1 | Mullion | KR822 (FLK as req) | 600 | | PR | | |
| 2 | Stabilizer | ST989 Dull Black | | | PR | | |
| 1 | Spacer | MCS822689 | | | PR | | |
| 1 | Rim Exit | xSPAR04867/NC-E11/NC-E35 | 19 | LD TB 43 70 56-SN200-8504 | | US32D | SA |
| 1 | Rim Exit | SPAR NC-E11 | LD 19 TB 43 8510 | EO | | US32D | SA |
| 2 | Interchangeable Core | I/CK-7 | 626 | | BE | | |
| 1 | Mullion Cylinder | 70 34 x 1KB-3 | | | US32D | SA | |
| 2 | Const. Core | 7190224 | Green | | BE | | |
| 1 | ElectroLynx Harness | QC-C1500P | | | | MK | |
| 2 | ElectroLynx Harness | QC-C***P (length as req'd) | | | | | MK |
| 1 | Power Supply | Provided by security | | | | SU | |
| 1 | Balance of hardware | Existing to remain | | | | | OT |

Notes: Doors are normally closed and secure. Presentation of valid credential will allow entry by pull. Upon loss of power, doors will remain secure. Free egress at all times. Reuse existing trim.

Set: 48.0

Doors: B101-1B

Description: Add SN200 Narrow Exit 8504 x 8510, EPT

| | | | | | | | |
|---|-------------------------|--------------------------|-------|---------------------------|----|-------|----|
| 1 | Electric Power Transfer | EL-CEPT | 630 | | SU | | |
| 1 | Mullion | KR822 (FLK as req) | 600 | | PR | | |
| 2 | Stabilizer | ST989 Dull Black | | | PR | | |
| 1 | Spacer | MCS822689 | | | PR | | |
| 1 | Rim Exit | xSPAR04867/NC-E11/NC-E35 | 19 | LD TB 43 70 56-SN200-8504 | | US32D | SA |
| 1 | Interchangeable Core | I/CK-7 | 626 | | BE | | |
| 1 | Const. Core | 7190224 | Green | | BE | | |
| 1 | ElectroLynx Harness | QC-C1500P | | | | | MK |

| | | | |
|---|---------------------|----------------------------|----|
| 2 | ElectroLynx Harness | QC-C***P (length as req'd) | MK |
| 1 | Power Supply | Provided by security | SU |
| 1 | Balance of hardware | Existing to remain | OT |

Notes: Doors are normally closed and secure. Presentation of valid credential will allow entry by pull. Upon loss of power, doors will remain secure. Free egress at all times.

Set: 49.0

Doors: J101A, J101C

Description: Add SN200 Narrow Exit 8504 Mullion - 8510 - Dogging

| | | | | | |
|---|-----------------------------------|----------------------------|---------------------------|-------|----------|
| 1 | Mullion | KR822 (FLK as req) | 600 | PR | |
| 2 | Stabilizer | ST989 Dull Black | | PR | |
| 1 | Spacer | MCS822 689 | | PR | |
| 1 | Rim Exit xSPAR04867/NC-E11/NC-E35 | | 19 TB 43 70 56-SN200-8504 | HK | US32D SA |
| 1 | Rim Exit xSPARNC-E11 | HK 19 TB 43 8510 | EO | | US32D SA |
| 2 | Interchangeable Core | I/CK-7 626 | | BE | |
| 1 | Mullion Cylinder | 70 34 x 1KB-3 | | US32D | SA |
| 2 | Const. Core | 7190224 | Green | BE | |
| 1 | ElectroLynx Harness | QC-C1500P | | MK | |
| 2 | ElectroLynx Harness | QC-C***P (length as req'd) | | MK | |
| 1 | Power Supply | Provided by security | | SU | |
| 1 | Balance of hardware | Existing to remain | | OT | |

Notes: Doors are normally closed and secure. Presentation of valid credential will allow entry by pull. Upon loss of power, doors will remain secure. Free egress at all times. Reuse existing trim

Set: 49.1

Doors: C137C

Description: Add SN200 Narrow Exit 8504 Mullion - 8510 - No Dogging

| | | | | | |
|---|-----------------------------------|----------------------------|------------------------------|-------|----------|
| 1 | Mullion | KR822 (FLK as req) | 600 | PR | |
| 2 | Stabilizer | ST989 Dull Black | | PR | |
| 1 | Spacer | MCS822 689 | | PR | |
| 1 | Rim Exit xSPAR04867/NC-E11/NC-E35 | | 19 LD TB 43 70 56-SN200-8504 | | US32D SA |
| 1 | Rim Exit SPAR NC-E11 | LD 19 TB 43 8510 | EO | | US32D SA |
| 2 | Interchangeable Core | I/CK-7 626 | | BE | |
| 1 | Mullion Cylinder | 70 34 x 1KB-3 | | US32D | SA |
| 2 | Const. Core | 7190224 | Green | BE | |
| 1 | ElectroLynx Harness | QC-C1500P | | MK | |
| 2 | ElectroLynx Harness | QC-C***P (length as req'd) | | MK | |
| 1 | Power Supply | Provided by security | | SU | |
| 1 | Balance of hardware | Existing to remain | | OT | |

Notes: Doors are normally closed and secure. Presentation of valid credential will allow entry by pull. Upon loss of power, doors will remain secure. Free egress at all times. Reuse existing trim

Set: 50.0

Doors: E131A, G101A

Description: Add SN200 Narrow Exit 8504 x Mullion - EPT

| | | | | |
|---|-------------------------|---------|-----|----|
| 1 | Electric Power Transfer | EL-CEPT | 630 | SU |
|---|-------------------------|---------|-----|----|

| | | | | | | |
|---|-----------------------------------|----------------------------|-------|------------------------------|-------|----|
| 1 | Mullion | KR822 (FLK as req) | 600 | PR | | |
| 2 | Stabilizer | ST989 Dull Black | | PR | | |
| 1 | Spacer | MCS822 689 | | PR | | |
| 1 | Rim Exit xSPAR04867/NC-E11/NC-E35 | | | 19 LD TB 43 70 56-SN200-8504 | US32D | SA |
| 2 | Interchangeable Core | I/CK-7 626 | | BE | | |
| 1 | Rim Cylinder | 70 34 X #90 - 1/2 | US32D | SA | | |
| 2 | Const. Core | 7190224 | Green | BE | | |
| 1 | ElectroLynx Harness | QC-C1500P | | | MK | |
| 2 | ElectroLynx Harness | QC-C***P (length as req'd) | | | | MK |
| 1 | Power Supply | Provided by security | | | SU | |
| 1 | Balance of hardware | Existing to remain | | | OT | |

Notes: Doors are normally closed and secure. Presentation of valid credential will allow entry by pull. Upon loss of power, doors will remain secure. Free egress at all times.

Set: 50.1

Doors: D123B, D173B, G142B, I120B
 Description: Add SN200 Narrow Exit 8504 - EPT

| | | | | | | |
|---|-----------------------------------|----------------------------|-------|------------------------------|-------|----|
| 1 | Electric Power Transfer | EL-CEPT | 630 | SU | | |
| 1 | Rim Exit xSPAR04867/NC-E11/NC-E35 | | | 19 LD TB 43 70 56-SN200-8504 | US32D | SA |
| 1 | Interchangeable Core | I/CK-7 626 | | BE | | |
| 1 | Const. Core | 7190224 | Green | BE | | |
| 1 | ElectroLynx Harness | QC-C1500P | | | MK | |
| 2 | ElectroLynx Harness | QC-C***P (length as req'd) | | | | MK |
| 1 | Power Supply | Provided by security | | | SU | |
| 1 | Balance of hardware | Existing to remain | | | OT | |

Notes: Doors are normally closed and secure. Presentation of valid credential will allow entry by pull. Upon loss of power, doors will remain secure. Free egress at all times. Reuse existing trim.

Set: 51.0

Doors: J101B, J101D
 Description: Add NL Narrow Exit 8504 Mullion - 8510 - Dogging

| | | | | | | |
|---|------------------------|---------------------|-----------|----|-------|----|
| 1 | Mullion | KR822 (FLK as req) | 600 | PR | | |
| 2 | Stabilizer | ST989 Dull Black | | PR | | |
| 1 | Spacer | MCS822 689 | | PR | | |
| 1 | Rim Exit xSPARNC-E11 | HK 19 TB 43 8510 | EO | | US32D | SA |
| 1 | Rim Exit Device/NC-E11 | HK 19 TB 43 70 8504 | Less Pull | | US32D | SA |
| 2 | Interchangeable Core | I/CK-7 626 | | BE | | |
| 1 | Mullion Cylinder | 70 34 x 1KB-3 | US32D | SA | | |
| 2 | Const. Core | 7190224 | Green | BE | | |
| 1 | Balance of hardware | Existing to remain | | | OT | |

Notes: Doors are normally closed and secure. Presentation of valid credential will allow entry by pull. Upon loss of power, doors will remain secure. Free egress at all times. Reuse existing trim

Set: 52.0

Doors: F101B

Description: Add NL Narrow Exit 8504 Mullion - 8510

| | | | | | | |
|---|--------------------------------|-------------------------------|------------|-------|----|--|
| 1 | Mullion | KR822 (FLK as req) | 600 | PR | | |
| 2 | Stabilizer | ST989 | Dull Black | PR | | |
| 1 | Spacer | MCS822689 | PR | | | |
| 1 | Rim Exit Device, x SPAR NC-E11 | LD 19 TB 43 8510 | EO | US32D | SA | |
| 1 | Rim Exit Device, x SPAR NC-E11 | LD 19 TB 43 70 8504 Less Pull | | US32D | SA | |
| 2 | Interchangeable Core | I/CK-7 | 626 | BE | | |
| 1 | Mullion Cylinder | 70 34 x 1KB-3 | US32D | SA | | |
| 2 | Const. Core | 7190224 | Green | BE | | |
| 1 | Balance of hardware | Existing to remain | | OT | | |

Notes: Doors are normally closed and secure. Presentation of valid credential will allow entry by pull. Upon loss of power, doors will remain secure. Free egress at all times. Reuse existing trim

Set: 53.0

Doors: A101, A114, B111-1, B111-2

Description: Add SN200 Exit, Loop

| | | | | | | |
|---|-----------------------------|------------------------------|-------|----|--|--|
| 1 | Rim Exit x SPAR04867/NC-E11 | 19 LD TB 43 70 56-SN200-8804 | US32D | SA | | |
| 1 | Interchangeable Core | I/CK-7 | 626 | BE | | |
| 1 | Const. Core | 7190224 | Green | BE | | |
| 1 | ElectroLynx Harness | QC-C1500P | | MK | | |
| 2 | ElectroLynx Harness | QC-C***P (length as req'd) | | MK | | |
| 1 | Door Loop | DL-2 | AK | | | |
| 1 | Power Supply | Provided by security | | SU | | |
| 1 | Balance of hardware | Existing to remain | | OT | | |

Notes: Doors are normally closed and secure. Presentation of valid credential will allow entry by pull. Upon loss of power, doors will remain secure. Free egress at all times. Reuse existing Trim.

Set: 54.0

Doors: J136A

Description: Add SN200 Exit PSB , Loop - CH, Peep

| | | | | | | |
|---|------------------------------------|----------------------------------|-------|----|--|--|
| 1 | Continuous Hinge CFM HD1 x Dr. Ht. | | | PE | | |
| 1 | Rim Exit SPAR04867/NC-E11 | LD 19 TB 43 70 56-SN200-8804 PSB | US32D | SA | | |
| 1 | Interchangeable Core | I/CK-7 | 626 | BE | | |
| 1 | Const. Core | 7190224 | Green | BE | | |
| 1 | ElectroLynx Harness | QC-C1500P | | MK | | |
| 2 | ElectroLynx Harness | QC-C***P (length as req'd) | | MK | | |
| 1 | Door Loop | DL-2 | AK | | | |
| 1 | Power Supply | Provided by security | | SU | | |
| 1 | Balance of hardware | Existing to remain | | OT | | |
| 1 | Viewer | 622 x door thickness | DCRM | RO | | |

Notes: Doors are normally closed and secure. Presentation of valid credential will allow entry by pull. Upon loss of power, doors will remain secure. Free egress at all times. Reuse existing Trim.

Set: 55.0

Doors: E160B, E164B, H130C

Description: Add SN200 Lock, Loop

| | | | | | | |
|---|----------------------|----------------------|-------------------|-------|----|----|
| 1 | SN200 Mort Lock 70 | SN200-82271 | OL | US26D | SA | |
| 1 | Interchangeable Core | I/CK-7 | 626 | BE | | |
| 1 | Const. Core | 7190224 | Green | BE | | |
| 1 | Gasketing | 2891APK | (head & jambs) | | PE | |
| 1 | ElectroLynx Harness | QC-C1500P | | | MK | |
| 1 | ElectroLynx Harness | QC-C***P | (length as req'd) | | | MK |
| 1 | Door Loop | DL-2 | AK | | | |
| 1 | Power Supply | Provided by security | | | SU | |
| 1 | Balance of hardware | Existing to remain | | | OT | |

Notes: Doors are normally closed and secure. Presentation of valid credential will allow entry by pull. Upon loss of power, doors will remain secure. Free egress at all times.

Set: 56.0

Doors: I142A

Description: Add 2N Lock, Bolt, 2891, Armor x 2

| | | | | | | |
|---|-----------------------|------------------------|-------------------|-------|----|----|
| 2 | Continuous Hinge CFM | HD1 x Dr. Ht. | | | PE | |
| 1 | Surface Bolt | 580-12 @ bottom only | | US26D | RO | |
| 1 | Fail Secure Lock - 2N | 70 8271 | LL | US26D | SA | |
| 1 | Interchangeable Core | I/CK-7 | 626 | BE | | |
| 1 | Const. Core | 7190224 | Green | BE | | |
| 2 | Armor Plate | K1050 36" | CSK BEV | US32D | RO | |
| 1 | Gasketing | 2891APK | (head & jambs) | | PE | |
| 1 | ElectroLynx Harness | QC-C1500P | | | MK | |
| 1 | ElectroLynx Harness | QC-C***P | (length as req'd) | | | MK |
| 1 | Door Loop | DL-2 | AK | | | |
| 1 | Power Supply | Provided by security | | | SU | |
| 1 | Balance of hardware | Existing to remain | | | OT | |
| 2 | Viewer | 622 x door thickness | DCRM | RO | | |
| 1 | Card reader | By security Contractor | | | OT | |

Notes: Doors are normally closed and secure. Presentation of valid credential will allow entry by pull. Upon loss of power, doors will remain secure. Free egress at all times.

Set: 57.0

Doors: H114A

Description: Add 2N Exit, 2891, Hinges

| | | | | | | |
|---|-----------------------------|--------------|--------------------------|-----------|-------|----|
| 3 | Hinge, Full Mortise, Hvy Wt | T4A3386 | NRP | US32D | MK | |
| 1 | Electric Power Transfer | EL-CEPT | 630 | SU | | |
| 1 | Rim Exit 2N SPAR | 04867/NC-E11 | 19 LD TB 43 56 70 8804 | Less Pull | US32D | SA |
| 1 | Vandal Resistant Trim | 826 | | US32D | SA | |
| 1 | Interchangeable Core | I/CK-7 | 626 | BE | | |
| 1 | Const. Core | 7190224 | Green | BE | | |
| 1 | Door Closer | TB 351 | PS | EN | SA | |
| 1 | Gasketing | 2891APK | (head & jambs) | | PE | |
| 1 | Threshold | 2005AT | MSES25SS X Opening Width | | | PE |
| 1 | ElectroLynx Harness | QC-C1500P | | | MK | |
| 1 | ElectroLynx Harness | QC-C***P | (length as req'd) | | | MK |
| 1 | Door Position Switch | By Security. | | | OT | |

| | | | |
|---|---------------------|------------------------|----|
| 1 | Power Supply | Provided by security | SU |
| 1 | Balance of hardware | Existing to remain | OT |
| 1 | Card reader | By security Contractor | OT |

Notes: Doors are normally closed and secure. Presentation of valid credential will allow entry by pull. Upon loss of power, doors will remain secure. Free egress at all times.

Set: 58.0

Doors: D153A
 Description: Add 2N Station

| | | | |
|---|---------------------|--------------------|----|
| 1 | Balance of hardware | Existing to remain | OT |
| 1 | 2N Station | 2N | OT |

Notes: Doors are normally closed and secure. Presentation of valid credential will allow entry by pull. Upon loss of power, doors will remain secure. Free egress at all times. Card reader by security. Reuse existing Trim.

Set: 59.0

Doors: A102, A104, A107, A112, A115, A116, A203, A207, A209, A214, A217, A218, B110, B201, B202, C103A, C104, C105, C105B, C106A, C110A, C114-2, C116, C116A, C116B, C121A, C121B, C122B, C123B, C127A, C128A, C129A, C130A, C131, C133B, C134, C139A, C140, C149A, C151A, C152A, C218A, C224A, C230B, C231A, C244A, C259A, C266A, D104A, D107A, D119A, D136A, D144A, D152A, D154A, D161A, D190A, D193A, D210A, D211A, D211B, D213A, D215A, D219A, D220A, D227A, D230A, D239A, D248A, E105A, E136A, E137A, E139B, E147A, E153A, E162A, E162B, E167A, E210A, E214A, E227A, E231A, E246A, E249A, E250A, E269A, F105B, F108A, F110A, F112A, F114A, F116A, F118B, F123A, F129B, F130A, G114B, G131A, G133A, G134A, G137A, G138A, G138B, G140A, G143A, H100B, H102A, H103A, H103B, H103C, H104C, H107A, H108B, H118A, H119A, H125A, H126A, H127B, H129A, H132B, H141A, H145A, H147B, H149A, H151B, H165B, H167A, H174A, H206A, H209A, H211A, I104A, I105A, I119A, I121A, I121B, I122A, I135A, I136A, I141, I141A, I205A, J108A, J109A, J119A, J121A, J124B, J127A, J137A, J144A, J144B, J147A, J148A, J150A, J151A, J153A, J161A, J163A, J172B, J178A, J182A
 Description: Existing - Add 8204

| | | | | |
|---|-----------------------|--------------------|-------|----|
| 1 | Storeroom/Closet Lock | 70 8204 LL | US26D | SA |
| 1 | Interchangeable Core | I/CK-7 626 | BE | |
| 1 | Const. Core | 7190224 | Green | BE |
| 1 | Door Stop | 481H | US26D | RO |
| 1 | Balance of hardware | Existing to remain | OT | |

Set: 59.1

Doors: C136, D217B
 Description: Existing - Add 8204 - HO Closer

| | | | | |
|---|-----------------------|---------------------|-----------------------|-------|
| 1 | Storeroom/Closet Lock | 70 8204 LL | US26D | SA |
| 1 | Interchangeable Core | I/CK-7 626 | BE | |
| 1 | Const. Core | 7190224 | Green | BE |
| 1 | Door Closer w/ HO | TB 351 H (inswing)/ | PSH (outswing) As Req | EN SA |
| 1 | Door Stop | 481H | US26D | RO |
| 1 | Balance of hardware | Existing to remain | OT | |

Set: 60.0

Doors: A104A, A206, C102, C109, C113A, C120A, C126A, C229A, C230A, C238A, C265A, C266B, D137A, D180A, D189A, D242A, E120A, E122A, E140A, E141A, E219A, E219B, E220A, E235A, E256A, E260A, F111A, G130A, H102C, H106A, H109A, H212A, H213A, I105, I106A, I130A, I138A, I140A, I201A, I202A, J100A, J200A, J202A, J210A

Description: Existing - Add 8204 -Closer - EX Mech / Elec

| | | | | |
|---|-----------------------|--------------------|-------|----|
| 1 | Storeroom/Closet Lock | 70 8204 LL | US26D | SA |
| 1 | Interchangeable Core | I/CK-7 626 | BE | |
| 1 | Const. Core | 7190224 | Green | BE |
| 1 | Surface Closer | TB 1431 UO | EN | SA |
| 1 | Door Stop | 481H | US26D | RO |
| 1 | Balance of hardware | Existing to remain | | OT |

Set: 61.0

Doors: D217A, E157A, H162A

Description: Existing - Add 8238 - HO Closer

| | | | | |
|---|----------------------------------|-------------------------------------|-------|----|
| 1 | Classroom Security Intruder Lock | V01 EMB 70 8238 VN1L 90-3/8" Collar | US26D | SA |
| 2 | Interchangeable Core | I/CK-7 626 | BE | |
| 2 | Const. Core | 7190224 | Green | BE |
| 1 | Surface Closer | TB 351 PSH | EN | SA |
| 1 | Door Stop | 481H | US26D | RO |
| 1 | Balance of hardware | Existing to remain | | OT |

Set: 62.0

Doors: C104A, C105A, C114A, C115A, C117A, C118A, C122A, C123A, C125A, C131A, C132A, C133A, C134A, C135A, C136A, C144A, C146A, C153A, C154A, C155A, C156A, C157A, C158A, C214A, C215A, C216A, C225A, C226A, C227A, C228A, C232A, C233A, C234A, C235A, C245A, C246A, C247A, C248A, C249A, C251A, C252A, C253A, C254A, C261A, C262A, C263A, C264A, C267A, C268A, C269A, C271A, D141A, D147A, D148A, D149A, D191A, D214B, D232A, D233A, D234A, D235A, D246A, E106A, E107A, E108A, E109A, E111A, E112A, E113A, E114A, E115A, E117A, E118A, E119A, E121A, E124A, E125A, E126A, E127A, E128A, E129A, E138A, E139A, E144A, E145A, E146A, E148A, E149A, E150A, E160A, E165B, E215A, E216A, E217A, E218A, E221A, E222A, E223A, E224A, E226A, E236A, E237A, E238A, E239A, E241A, E242A, E243A, E244A, E251A, E252A, E253A, E254A, E257A, E258A, E259A, E261A, E264A, E265A, E266A, E267A, F103A, F105A, G136A, G142A, H108A, H113A, H117A, H127A, H132A, H133A, H136A, H137A, H147A, H165A, H201A, H202A, H203A, H204A, H205A, J203A, J204A, J205A, J206A, J207A, J208A, J209A

Description: Existing - Add 8238 - Rated Classroom - Closer

| | | | | |
|---|----------------------------------|-------------------------------------|-------|----|
| 1 | Classroom Security Intruder Lock | V01 EMB 70 8238 VN1L 90-3/8" Collar | US26D | SA |
| 2 | Interchangeable Core | I/CK-7 626 | BE | |
| 2 | Const. Core | 7190224 | Green | BE |
| 1 | Door Closer | TB 351 O/P9 (type as required) | EN | SA |
| 1 | Door Stop | 481H | US26D | RO |
| 1 | Balance of hardware | Existing to remain | | OT |

Set: 63.0

Doors: C212A, D237A, F125A, F128A, J154A

Description: Existing - Add 8238

| | | | | |
|---|----------------------------------|-------------------------------------|-------|----|
| 1 | Classroom Security Intruder Lock | V01 EMB 70 8238 VN1L 90-3/8" Collar | US26D | SA |
| 2 | Interchangeable Core | I/CK-7 626 | BE | |
| 2 | Const. Core | 7190224 | Green | BE |

| | | | | | | |
|---|---------------------|------|--------------------|----|----|--|
| 1 | Door Stop | 481H | US26D | RO | | |
| 1 | Balance of hardware | | Existing to remain | | OT | |

Set: 64.0

Doors: D133A, D134A

Description: Existing - Add 8250

| | | | | | | |
|---|---------------------------------|---------|--------------------|-------|-------|----|
| 1 | Hotel Guest Lock | Lock | V20 LC 8250 VN1L | | US26D | SA |
| 1 | Interchangeable Core | | I/CK-7 626 | BE | | |
| 1 | Const. Core | 7190224 | | Green | BE | |
| 1 | Mortise Cylinder for Hotel Lock | | 1E-7G4 C208 RP3 | | 626 | BE |
| 1 | Door Stop | 481H | US26D | RO | | |
| 1 | Balance of hardware | | Existing to remain | | OT | |

Set: 64.1

Doors: H139A, H151A

Description: Existing - Add 8251

| | | | | | | |
|---|-------------------------|---------|--------------------|-------|-------|----|
| 1 | Storeroom Deadbolt Lock | | V20 70 8251 VN1L | | US26D | SA |
| 1 | Interchangeable Core | | I/CK-7 626 | BE | | |
| 1 | Const. Core | 7190224 | | Green | BE | |
| 1 | Door Stop | 481H | US26D | RO | | |
| 1 | Balance of hardware | | Existing to remain | | OT | |

Set: 65.0

Doors: I128A

Description: Existing - Add 8204 - Custodial - HO Closer

| | | | | | | |
|---|-----------------------|---------|------------------------------------|--------|-------|----|
| 1 | Storeroom/Closet Lock | | 70 8204 LL | | US26D | SA |
| 1 | Interchangeable Core | | I/CK-7 626 | BE | | |
| 1 | Const. Core | 7190224 | | Green | BE | |
| 1 | Door Closer w/ HO | | TB 351 H (inswing)/ PSH (outswing) | As Req | EN | SA |
| 1 | Door Stop | 481H | US26D | RO | | |
| 1 | Balance of hardware | | Existing to remain | | OT | |

Set: 66.0

Doors: I114A

Description: Existing - Add 8237 - Custodial - HO Closer

| | | | | | | |
|---|----------------------|---------|------------------------------------|--------|-------|----|
| 1 | Classroom Lock | | 70 8237 LL | | US26D | SA |
| 1 | Interchangeable Core | | I/CK-7 626 | BE | | |
| 1 | Const. Core | 7190224 | | Green | BE | |
| 1 | Door Closer w/ HO | | TB 351 H (inswing)/ PSH (outswing) | As Req | EN | SA |
| 1 | Door Stop | 481H | US26D | RO | | |
| 1 | Balance of hardware | | Existing to remain | | OT | |

Set: 67.0

Doors: C109A, C143A, C221A, C256A, E102A, E133A, E211A, J170A

Description: Existing - Add 8204 - Closer - Rated Custodial

| | | | | | | |
|---|-----------------------|---------|--------------------------------|-------|-------|----|
| 1 | Storeroom/Closet Lock | | 70 8204 LL | | US26D | SA |
| 1 | Interchangeable Core | | I/CK-7 626 | BE | | |
| 1 | Const. Core | 7190224 | | Green | BE | |
| 1 | Door Closer | | TB 351 O/P9 (type as required) | | EN | SA |
| 1 | Door Stop | 481H | US26D | RO | | |

1 Balance of hardware Existing to remain OT

Set: 68.0

Doors: B102

Description: Existing - Add 8237 - Closer - Rated Custodial

1 Classroom Lock 70 8237 LL US26D SA
 1 Interchangeable Core I/CK-7 626 BE
 1 Const. Core 7190224 Green BE
 1 Door Closer TB 351 O/P9 (type as required) EN SA
 1 Door Stop 481H US26D RO
 1 Balance of hardware Existing to remain OT

Set: 69.0

Doors: 2057-1, A106-1, A106-2, A111-1, A111-2, A213-1, A213-2, B103, C104B, C107-1, C107-2, C114B, C115B, C117B, C118B, C127B, C127C, C135, C135B, C145A, C154B, C155B, C157B, D121A, D132A, D147B, D212A, D214A, E143A, E143B, E150B, E156A, E163A, E163B, E232A, E233A, E234A, F107A, G126A, G132A, H101A, H104B, H116A, H120A, H134A, H142A, H143A, H146A, H146B, H152A, H164A, H169A, I111A, I112A, I123A, I126A, I131A, J103A, J106A, J124A, J124C, J133A, J149A, J149B, J154B, J156A, J159A, J161B, J165A, J172A, J172C

Description: Existing - Add 8237

1 Classroom Lock 70 8237 LL US26D SA
 1 Interchangeable Core I/CK-7 626 BE
 1 Const. Core 7190224 Green BE
 1 Door Stop 481H US26D RO
 1 Balance of hardware Existing to remain OT

Set: 70.0

Doors: E165A

Description: Existing - Add 8237 - 10XU15 - Dutch door

1 Passage Latch 10XU15 LL US26D SA
 1 Classroom Lock 70 8237 LL US26D SA
 1 Interchangeable Core I/CK-7 626 BE
 1 Const. Core 7190224 Green BE
 1 Door Stop 481H US26D RO
 1 Balance of hardware Existing to remain OT

Set: 71.0

Doors: C213A, C242A, C243A, D103A, D106A, D108A, D109A, D111A, D112A, D113A, D114A, D115A, D116A, D117A, D118A, D124A, D124B, D126A, D127A, D128A, D129A, D131A, D135A, D138A, D139A, D156A, D157A, D162A, D164A, D165A, D166A, D167A, D168A, D169A, D169B, D169C, D172A, D175A, D177A, D177C, D181A, D181B, D182A, D182B, D183A, D183B, D185A, D185B, D188A, D241A, D244A, E228A, E229A, H207A

Description: Existing - Add 8205

1 Office/Entry Lock 70 8205 LL US26D SA
 1 Interchangeable Core I/CK-7 626 BE
 1 Const. Core 7190224 Green BE
 1 Door Stop 481H US26D RO
 1 Balance of hardware Existing to remain OT

Set: 72.0

Doors: C132, C147A, C148A, D145A, D150A, E142A, E159A, E161A, H101B, H166A, I113A, I124A, I127A, J158A
Description: Existing - Add 8265

| | | | | | |
|---|---------------------|---------------|--------------------|----|----|
| 1 | Privacy Lock | V20 8265 VN1L | US26D | SA | |
| 1 | Door Stop | 481H | US26D | RO | |
| 1 | Balance of hardware | | Existing to remain | | OT |

Set: 73.0

Doors: C150A, E158A
Description: Existing - Add 8215

| | | | | | |
|---|---------------------|---------|--------------------|----|----|
| 1 | Passage Latch | 8215 LL | US26D | SA | |
| 1 | Door Stop | 481H | US26D | RO | |
| 1 | Balance of hardware | | Existing to remain | | OT |

Set: 74.0

Doors: H115A, H115B
Description: Existing - Add 8226

| | | | | | |
|---|----------------------|------------|--------------------|----|----|
| 1 | Store Door Lock | 70 8226 LL | US26D | SA | |
| 1 | Interchangeable Core | I/CK-7 626 | | BE | |
| 1 | Const. Core | 7190224 | Green | BE | |
| 1 | Door Stop | 481H | US26D | RO | |
| 1 | Balance of hardware | | Existing to remain | | OT |

Set: 76.0

Doors: E166C, H100A, H130A, H130B, H171B, H171C, H171D, H171E, H171F, H171G
Description: **OH Coiling Doors - No Work

| | | | | | |
|---|--------------|--|--------------------|--|----|
| 1 | All hardware | | Existing to remain | | OT |
|---|--------------|--|--------------------|--|----|

Set: 77.0

Doors: A201, A216, B104, B108, B109, D123A, D151B, D158A, D178A, D179A, D218A, D221B, D222A, D225A, D247A, E152A, E152B, E166B, E263A, E268A, F115A, F115B, F122A, F122B, F123B, H110A, H111A, H112, H112A, H112B, H112C, H112D, H112E, H170A, J102B, J105B, J117C, J125A, J134A, J135A, J135B, J141A, J142A, J142B, J143A, J145A, J145B, J152A, J162A, J177A, J180A, J180B
Description: No Work

| | | | | | |
|---|--------------|--|--------------------|--|----|
| 1 | All hardware | | Existing to remain | | OT |
|---|--------------|--|--------------------|--|----|

Set: 78.0

Doors: X102
Description: **OH Coiling Doors - Manual

| | | | | | |
|---|---|------------|-------|----|----|
| 1 | Mortise Cylinder | 70 42 | US32D | SA | |
| 1 | Interchangeable Core | I/CK-7 626 | | BE | |
| 1 | Const. Core | 7190224 | Green | BE | |
| 1 | Balance hardware by the door manufacturer | | | | OT |

Notes: Provide keyswitch on both sides of door.

Set: 79.0

Doors: X112

Description: **Gate - Panic

| | | | | | | |
|---|---------------------------|--------------------------|---------------------|-------|-------|----|
| 1 | Hinges | By the door manufacturer | | OT | | |
| 1 | Exit Device - SPAR#NC-E11 | | 19 LD TB 43 70 8804 | | US32D | SA |
| 1 | Vandal Resistant Trim | 826 | | | US32D | SA |
| 1 | Interchangeable Core | I/CK-7 626 | | | BE | |
| 1 | Const. Core | 7190224 | | Green | BE | |
| 1 | Balance hardware | by the door manufacturer | | | | OT |

Set: 80.0

Doors: X103, X113

Description: **Gate - Pr Panic

| | | | | | | |
|---|---------------------------|--------------------------|---------------------|-------|-------|----|
| 1 | Hinges | By the door manufacturer | | OT | | |
| 1 | Mullion | KR822 (FLK as req) | 600 | | PR | |
| 2 | Stabilizer | ST989 Dull Black | | | PR | |
| 1 | Spacer | MCS822689 | | | PR | |
| 1 | Rim Exit EO x SPAR#NC-E11 | | 19 LD TB 43 8810 | | US32D | SA |
| 1 | Exit Device - SPAR#NC-E11 | | 19 LD TB 43 70 8804 | | US32D | SA |
| 1 | Vandal Resistant Trim | 826 | | | US32D | SA |
| 1 | Vandal Resistant Trim | 821 | | | US32D | SA |
| 2 | Interchangeable Core | I/CK-7 626 | | | BE | |
| 2 | Const. Core | 7190224 | | Green | BE | |
| 1 | Balance hardware | by the door manufacturer | | | | OT |

Notes: Provide adequate framing (by others) for mullion.

Set: 81.0

Doors: X105, X106, X107, X108, X109, X110, X114, X115

Description: **Fence Gate

| | | | | | | |
|---|----------------------|--------------------------|--|-------|----|----|
| 1 | Hinges | By the door manufacturer | | OT | | |
| 1 | Interchangeable Core | I/CK-7 626 | | | BE | |
| 1 | Const. Core | 7190224 | | Green | BE | |
| 1 | Balance hardware | by the door manufacturer | | | | OT |

Set: 82.0

Doors: Attic

Description: **Attic Stock - EVERY CAMPUS

| | | | | | | |
|----|-------------------------------|-----------------|-------------------|-------|------|----|
| 1 | Hydraulic Gate Closer & Hinge | | MAMMOTH-180-HD | | 9005 | OT |
| 5 | Quick Fix Bolts | | MAMMOTH-P00006000 | | | OT |
| 5 | Mullion Lock | 98-2520 | | | SA | |
| 5 | Mullion Lock | 98-2518 | | | SA | |
| 50 | Interchangeable Core | I/CK-7 626 | | | BE | |
| 20 | Const. Core | 7190224 | | Green | BE | |
| 50 | Key Blanks | Best "A" Keyway | | | BE | |
| 2 | Electric Strike | 9400 630 | | | HS | |
| 2 | Electric Strike | 9500 630 | | | HS | |
| 12 | Regular Hold Open Arm | 25-H | | | EN | SA |
| 12 | Parallel Hold Open Arm | 25-PSH | | | EN | SA |
| 4 | Electromagnetic Holder | | 994M 24VAC | | 689 | RF |

| | | | | | |
|---|---------------------|---------------------------|-----|----|----|
| 5 | 994M Magnetic Parts | Door Armature 994510M | 689 | RF | |
| 5 | 994M Magnetic Parts | Screw & Backplate 998300 | 689 | RF | |
| 5 | 994M Magnetic Parts | Swivel Armature 900-3 | 689 | RF | |
| 5 | 994M Magnetic Parts | Magnet Assembly 998369-3V | 689 | RF | RF |
| 5 | 994M Magnetic Parts | Wall Cover 998315M | 689 | RF | |
| 5 | Motor Assembly Kit | M56A F x SPAR05338 | | SA | |
| 4 | SN200 Reader | 52 6027 (Exit / Lock) | 26D | SA | |

Notes: All attic stock ships direct to
Director of Technical Services
Cy Fair ISD Lockshop
11430 Perry Road
Houston, Texas 77064

All attic stock to ship directly to CyFair from the distributor
Do not deliver to jobsite

END OF SECTION

SECTION 08 80 00 - GLAZING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:
 - 1. Doors.
 - 2. Storefront framing.
 - 3. Interior borrowed lites.
 - 4. Stainless Steel speak thru

1.2 DEFINITIONS

- A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.
- C. Interspace: Space between lites of an insulating-glass unit.

1.3 PERFORMANCE REQUIREMENTS

- A. General: Installed glazing systems shall 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.
- B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
 - 2. corrective measures including the use of specially formulated primers.

1.4 ACTION SUBMITTALS

- A. Product Data: For each glass product and glazing material indicated.
- B. Glass Samples: For each type of the following products; 12 inches square.
 - 1. Tempered glass.
 - 2. Laminated glass.
 - 3. Insulating glass.
 - 4. Security glass.
 - 5. Fire-rated glass

- C. Glazing Accessory Samples: For gaskets, sealants, and colored spacers, in 12-inch lengths. Install sealant Samples between two strips of material representative in color of the adjoining framing system.
- D. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.
- E. 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.

1.5 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For glass and glazing products, from manufacturer.
- B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for insulating glass.
- C. Warranties: Sample of special warranties.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer who is approved and certified by coated-glass manufacturer.
- B. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.
- C. Source Limitations for Glass: Obtain insulating glass from single source from single manufacturer for each glass type.
- D. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.
- E. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
- F. Safety Glazing Labeling: Where safety glazing labeling is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- G. Security Glazing Labeling: Where security glazing labeling is indicated, permanently mark glazing with certification label meeting ASTM F1233-08 or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and security glazing standard with which glass complies.
- H. Preinstallation Conference: Conduct conference at Project site.
 - 1. construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 2. Review temporary protection requirements for glazing during and after installation.

1.7 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
- B. Comply with insulating-glass manufacturer's written recommendations for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.8 PROJECT 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 below 40 deg F.

1.9 WARRANTY

- A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer's standard form in which coated-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: 5 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GLASS PRODUCTS, GENERAL

- A. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.
 - 1. Minimum Glass Thickness for Exterior Lites: Not less than 1/4" min.
- B. Strength: fully tempered glass, provide Kind FT heat-treated float glass.

2.2 GLASS PRODUCTS

- A. Clear and Tinted Float Glass Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. AGC Flat Glass North America, Inc: www.na.agc-flatglass.com.
 - 2. Ford Glass Division
 - 3. Guardian Industries, Corp.
 - 4. LOF Glass, Inc..
 - 5. PPG Industries, Inc: www.ppgideascape.com.
 - 6. Saint-Gobain/Euroglass.

- B. Heat-Treated Float Glass: ASTM C 1048; Type I; Quality-Q3; Class I (clear) unless otherwise indicated; of kind and condition indicated.

1. Cardinal IG
2. Environmental Glass Products
3. Falconer Glass Industries
4. Hordis Brothers, Inc..
5. Ford Glass Division
6. Guardian Industries, Corp.
7. LOF Glass, Inc..
8. PPG Industries, Inc: www.ppgideascape.com.
9. Saint-Gobain/Euroglass.
10. Spectrum Glass Products Div. H.H. Robertson, Co.

2.3 SECURITY GLAZING

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Global Security Glazing - A CGH Company.
2. Product: Child Guard Security Glazing
 - a. Laminated security glass product consisting of security inner layer of glass with a custom security, heat strengthened, chemically bonded core
 - 1) See GL type for thickness
 - b. All childgard glass panels must have product stencil/logo number identified on every panel.

- B. Glass Units: Factory-assembled units consisting of glass clad polycarbonate IGU and contains an exposed polycarbonate surface with an abrasion resistant coating on the witness (safe) side.

1. Product code: SP175 IGU.

2.4 FIRE-PROTECTION-RATED GLAZING

- A. Fire-Protection-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 shall comply with NFPA 80.

1. Fire-protection-rated glazing required to have a fire-protection rating of 20 minutes shall be exempt from the hose-stream test.

- B. Fire-Protection-Rated Glazing Labeling: Permanently mark fire-protection-rated glazing with certification label of a testing agency acceptable to authorities having jurisdiction. Label shall indicate 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 deg F (250 deg C) temperature-rise limitation; and the fire-resistance rating in minutes.

- C. Wire Safety Glazing: Clear wire safety glass, Type II, Class 1, Form 1, Quality q7. Wire grid pattern shall be square and parallel to edges. The wire glass shall be UL certified and labeled. Provide necessary documentation as required.

2.5 GLAZING GASKETS

- A. Dense Compression Gaskets: Molded or extruded gaskets of profile and hardness required to maintain watertight seal, made from one of the following:
 - 1. EPDM complying with ASTM C 864.
 - 2. Silicone complying with ASTM C 1115.
 - 3. Thermoplastic polyolefin rubber complying with ASTM C 1115.
- B. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned EPDM, silicone or thermoplastic polyolefin rubber gaskets complying with ASTM C 509, Type II, black; of profile and hardness required to maintain watertight seal.
 - 1. Application: Use where soft compression gaskets will be compressed by inserting dense compression gaskets on opposite side of glazing or pressure applied by means of pressure-glazing stops on opposite side of glazing.

2.6 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

2.7 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.
- B. 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.
- C. Grind smooth and polish exposed glass edges and corners.

2.8 GLASS TYPES

- A. Glass Type GL-1: Insulated/Laminated Glass.
 - 1. Solar Control Low-E Glass: Tinted glass; with the following minimum characteristics: Provide safety glazing labeling.
 - a. Transmittance
 - 1) VLT - 50%
 - b. Reflectance

- 1) Outside - 8%
 - c. U-Value (NFRC)
 - 1) Winter Night-time: 0.29
 - d. Shading Coefficient: 0.29
 - e. Solar Heat Gain Coefficient: 0.25
 2. Product: Oldcastle Glass "SunGlass"
 - a. Other Available Manufacturer's
 - 1) Viracon
 - 2) AFG Industries Inc.
 - 3) Pilkington Building Products
 - 4) PPG Industries, Inc.
 3. Color: Match existing glass tint on the remainder of the school.
 4. Exterior Window Thickness: 1- 5/16 inch (one outside layer of 1/4 inch SunGlass on radiant low e #2, 1/2 inch airspace, inside layer of 9/16 inch laminated glass [1/4 inch tinted, 0.060 inch PVB interlayer and 1/4 inch tinted]). Edge seal shall be compatible with glazing compound, joint sealers, adjacent materials, and glazing accessories.
- B. Glass Type GL-2: Insulated/Impact Resistant Security Glass
 1. Same as GL-1 with added security film.
- C. Glass Type GL-3: Not Used.
- D. Type GL-4 - Interior Laminated Security Glass:
 1. Product: Child Guard
 - a. Laminated glass product consisting of inner layer of security glass with a custom security, heat strengthened, chemically bonded core
 - b. ASTM C 1036, ASTM C 1048, ASTM C 1349, ASTM C 1172
 - c. 3/8 inch thickness
 2. Color: Clear.
- E. Type GL-5 - Interior Laminated Glass:
 1. Layer of 19/32 inch laminated glass (1/4 inch tinted, 0.060 inch PVB interlayer and 1/4 inch tinted)
 2. Color: Clear.
- F. Type GL-6: Fully tempered float glass.
 1. Thickness: 3/8 inch thick.
 2. Provide safety glazing labeling.
 3. Recommended Clearance: Face: 1/8" per side, Edge: 3/8" and Bite: 1"
 4. Color: Clear
- G. Type GL-7 - Interior Laminated Security Glass:
 1. Product: Child Guard
 - a. Laminated glass product consisting of inner layer of security glass with a custom security, heat strengthened, chemically bonded core
 - b. ASTM C 1036, ASTM C 1048, ASTM C 1349, ASTM C 1172
 - c. 9/16 inch thickness
 2. Color: Clear.

- H. Type GL-8 - Interior Laminated Security / Fire Rated Glass:
 - 1. Layer of 9/16 inch clear laminated child guard security glass [9/16 inch clear, 0.060 inch PVB interlayer and 1" fire rated glass)
 - 2. Laminated glass product consisting of inner layer of security glass with a custom security, fire rated assembly.
 - 3. Fire rated glazing to be Global FRP 300 inferno-lite 1" - 90 min. fire resistant glazing
 - 4. Tint Color: Clear

- I. Type GL-9 - Clear wire fire rated safety glass.
 - 1. CAT II impact-rated
 - 2. Thickness: 1/4 inch thick with 3/4" x 3/4" wire mesh.
 - 3. Provide fire rated glazing etched with UL labeling.

- J. Type GL-10 - Clear laminated insulating acoustical glass:
 - 1. Overall thickness: 1-1/6 inch
 - 2. Outdoor lite: Clear laminated float glass consisting of 2 lites 1/8 inch thick clear, heat strengthened glass with 0.060 inch PVB interlayer.
 - 3. 1/2 inch air space
 - 4. Indoor lite: Clear float glass, 6 mm thick, heat strengthened.
 - 5. STC: 40 minimum

2.9 Stainless Steel Speak Thru

- A. Provide two bullet resistant stainless steel speak thru devices at reception windows as indicated. Product number: CSE-QS-BR-NV-SpkThru-L3. Coordinate with impact resistant glazing thickness.

- B. Bullet Resistant Stainless Steel Speaker: CSE-QS-BR-NV-SpkThru-L3 Covenant Security Equipment.

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 those for 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 only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

- B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that will leave visible marks in the completed work.

3.3 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.
- C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
- D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- E. 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.
- F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- G. Provide spacers for glass lites where length plus width is larger than 50 inches.
 - 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 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.
- H. 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.
- I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- J. Set glass lites with proper orientation so that coatings face exterior or interior as specified.
- K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.
- L. Provide glazing materials and installation for the bullet resistant glazing as approved by the glazing manufacturer. All glass should be installed in accordance with the guidelines set forth in the current edition of the glass association of North America (GANA) Glazing and Sealant Manuals.

3.4 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. 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.
- C. 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.
- D. 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.
- E. Install gaskets so they protrude past face of glazing stops.

3.5 CLEANING AND PROTECTION

- A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.
- C. 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; remove as recommended in writing by glass manufacturer.
- D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.
- E. Wash glass on both exposed surfaces in each area of Project 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.

END OF SECTION

SECTION 08 87 16 - SAFETY AND SECURITY WINDOW FILM

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Security Glazing film applied to new and existing glazing assemblies.
 - 2. Locations: As identified in the Contract Documents.
- B. Related Sections:
 - 1. Section 08 80 00 "Glazing" for impact-resistant security glass.

1.2 REFERENCED STANDARDS

- A. American National Standards Institute (ANSI)
 - 1. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings, Safety Performance Specifications and Methods of Test; Current Version.
- B. American Society for Testing and Materials (ASTM)
 - 1. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; Current Version.
 - 2. ASTM F3561.- Standard Test Method for Forced-Entry-Resistance of Fenestration Systems After Simulated Active Shooter Attack. FTD SA - FILTI Shooter Attack Certification Testing, Filti Testing and Development Shooter Attack Certification.
- C. Code of Federal Regulations
 - 1. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; Consumer Products Safety Commission; current edition.

1.3 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Glazing film manufacturer specializing in manufacture of security glazing films with minimum 5 years' experience manufacturing products meeting specified requirements.
- B. Installer Qualifications: Direct employees of film manufacturer or manufacturer-approved installers trained in all aspects of film installation.
- C. Field Mockup: Apply security glazing film in location(s) as directed to verify installation requirements and to demonstrate application effects and qualities of materials and execution.
 - 1. Obtain approval of field samples before continuing with remainder of installation.
 - 2. Maintain mockup during duration of installation in an undisturbed condition as a standard for judging the completed Work.
 - 3. Approved field mockup may become part of the completed Work.
- D. Film application and performance verification:

1. In addition to only proceeding with reviewed and approved submittals, the awarded contractor/ installer shall certify that the security film installed meets the performance requirements identified within the Contract Documents.
2. Post installation film verification may include the random choosing and removal of up to three pieces of glass with applied film to be tested to verify that film installed meets specification and performance requirements as indicated. Film may need to be removed as part of the verification process.
3. All installed film locations shall be subject to inspection of structural sealant to verify full bite on frames has been achieved.

1.4 SUBMITTALS

- A. Submit under provisions of Division 01.
- B. Test Reports: Detailed reports of full-scale chamber tests to specified criteria, using assemblies commensurate with those required for this project.
- C. Product Data: Manufacturer's data sheets on product to be used, including:
 1. Record of product certification for safety requirements.
 2. Preparation instructions and recommendations.
 3. Storage and handling requirements and recommendations.
 4. Installation methods.
- D. Samples: For each film product to be used, minimum size 4-inches by 6-inches, representing actual product, color, and patterns.
- E. Specimen Warranty.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store products as directed 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.

1.6 FIELD CONDITIONS

- A. Coordinate installation timeline with General Contractor's and/or Owner's schedule and potential other adjacent work that may create or cause adverse installation conditions.
- B. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside the manufacturer's absolute limits.

1.7 WARRANTY

- A. Provide 15 Year manufacturers replacement warranty to cover film against peeling, cracking, discoloration, and deterioration.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design: 23mil Shooter Attack Security Film as manufactured by Armoured One, LLC; www.armouredone.com.
 - 1. Substitutions: Must provide demonstrated equality to specified basis of design product and performance requirements.

2.2 MATERIALS

- A. Security Glazing Film
 - 1. Single thickness 23 mil (0.023 inch) thick, clear, UV stable, optically transparent, adhesive backed polyester film for permanent bonding to glass.
 - a. Installing multiple layers of thinner film to accomplish the required thickness is not acceptable nor considered equal to the basis of design.
 - 2. Adhesive Type: Pressure sensitive as recommended by glazing film manufacturer.
 - 3. Performance Requirements:
 - a. FTD SA - Standard for Shooter Attack certification, Class 1 (tested on 1/4-inch tempered glass).
 - b. Tensile Strength: ASTM D-882, 35,000 psi minimum.
 - c. Breaking Strength: ASTM D-882, 640 lbs. / inch.
 - d. Elongation at Break: ASTM D-882, 230%
 - e. Haze: ASTM D1003, <4%
 - f. Color b: ASTM D2244, 4.2
 - g. 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).
 - 4. Cleaners, Primers, and Sealers: Types recommended by glazing film manufacturer.
- B. Anchoring System
 - 1. Structural Sealant: Per manufacturer's recommendations for the installation application.
 - a. Acceptable product: DOW Corning DOWSIL795 Silicone Building Sealant, DOWSIL 995 Structural Silicone Sealant, or glazing film manufacturer approved equal.
 - 2. Provide supplemental anchoring system components as required.

PART 3 - EXECUTION

3.1 GENERAL

- A. At existing glazed openings, retrofit glazing assemblies to provide impact resistance and forced/attack resistance complying with FTD-SA-C1, ANSI Z97. I and CPSC 16 CFR 1201 Category II.

3.2 EXAMINATION

- A. Field-Applied Film: Verify that existing conditions are adequate for proper application and performance of film.
- B. Examine glass and frames, ensure 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.

3.3 PREPARATION

- A. Clean glass of dust, dirt, paint, oil, grease, mildew, mold, and other contaminants that would inhibit adhesion.
- B. Blade the inside surface of window glass with industrial razors to ensure removal of foreign contaminants.
- C. Immediately prior to applying film, thoroughly wash glass with neutral cleaning solution.
- D. Protect adjacent surfaces.
- E. Do not begin installation until substrates have been properly prepared.

3.4 INSTALLATION

- A. Install in accordance with manufacturer's instructions, without air bubbles, wrinkles, streaks, bands, thin spots, pinholes, or gaps, as required to achieve specified performance.
- B. Seams. Seam film only as required to accommodate material sizes, seam without overlaps. Seam orientation to be identified and coordinated during shop drawing review and verified in field prior to installation.
- C. Apply bead of structural sealant overlapping 3/4-inch of the exposed edge of film and overlapping 3/4-inch of glazing system frame. Allow to cure before cleaning.
- D. Clean glass and excess structural sealants from finished surfaces.
- E. Remove any labels or protective covers. Do not encapsulate anything under the film.

3.5 POST INSTALLATION VERIFICATION

- A. Awarded contractor will be required to verify that film installed meets the requirements highlighted in this bid. By submitting a bid, contractor understands that three pieces of glass, chosen at random will be removed and film applied will be measured to verify that film installed meets specifications as requested. Film may need to be removed as part of the verification process.

3.6 PROTECTION

- A. Protect installed products until completion and final acceptance of project.

- B. Repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 08 90 00 - LOUVERS AND VENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Fixed, extruded-aluminum louvers.

1.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design louvers, including comprehensive engineering analysis by a qualified professional engineer, using structural performance requirements and design criteria indicated.
- B. Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.
 - 1. Wind Loads: Determine loads based on pressures as indicated on Drawings.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes, without buckling, opening of joints, overstressing of components, failure of connections, or other detrimental effects.
 - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
- D. Louver Performance Ratings: Provide louvers complying with requirements specified, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width according to AMCA 500-L.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.
- B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.
 - 1. Show weep paths, gaskets, flashing, sealant, and other means of preventing water intrusion.
 - 2. Show mullion profiles and locations.
 - 3. Wiring Diagrams: For power, signal, and control wiring for motorized adjustable louvers.
- C. Samples for Verification: For each type of metal finish required.

- D. Delegated-Design Submittal: For louvers indicated to comply with structural performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- E. 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. Reference standard ANSI/ACMA Standard 550-09.

1.4 QUALITY ASSURANCE

- A. 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.
- B. Welding: Qualify procedures and personnel according to the following:
 - 1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
 - 2. AWS D1.3, "Structural Welding Code - Sheet Steel."
 - 3. AWS D1.6, "Structural Welding Code - Stainless Steel."
- C. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.
- D. UL and NEMA Compliance: Provide motors and related components for motor-operated louvers that are listed and labeled by UL and comply with applicable NEMA standards.

1.5 PROJECT CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.6 WARRANTY

- A. Special Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Aluminum Extrusions: ASTM B 221, Alloy 6063-T5, T-52, or T6.
- B. Aluminum Sheet: ASTM B 209, Alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer for required finish.

- C. Aluminum Castings: ASTM B 26/B 26M, Alloy 319.
- D. 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.
- E. Postinstalled 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 per ASTM E 488, conducted by a qualified independent testing agency.
- F. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.2 FABRICATION, GENERAL

- A. Assemble louvers in factory to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- B. Maintain equal louver blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.
- C. 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.
- D. Include supports, anchorages, and accessories required for complete assembly.
- E. Provide vertical mullions of type and at spacings indicated, but not more than recommended by manufacturer, or 72 inches 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 and welded blades and with fully recessed mullions at corners.
- F. Provide subsills made of same material as louvers for recessed louvers.
- G. 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.

2.3 FIXED, EXTRUDED-ALUMINUM LOUVERS

A. Horizontal Storm-Resistant Louver, Drainable:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Airolite Company, LLC.
 - b. Construction Specialties, Inc.
 - c. Greenheck Fan Corporation.
 - d. Nystrom Building Products.
 - e. Reliable Products, Inc.
 - f. Ruskin Company.
2. Louver Depth: 6 inches or as indicated on drawings.
3. Frame and Blade Nominal Thickness: Not less than 0.080 inch.
4. Louver Performance Ratings:
 - a. Free Area: Not less than as required by mechanical equipment as indicated on drawings.
 - b. Wind-Driven Rain Performance: Not less than 95 percent effectiveness when subjected to a rainfall rate of 8 inches per hour and a wind speed of 50 mph.
5. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

2.4 LOUVER SCREENS

A. General: Provide screen at each exterior louver.

1. Screen Location for Fixed Louvers: Interior face.
2. Screening Type: Bird screening except where insect screening is indicated.

B. Secure screen frames to louver frames with stainless-steel machine screws, spaced a maximum of 6 inches from each corner and at 12 inches o.c.

C. Louver Screen Frames: Fabricate with mitered corners to louver sizes indicated.

1. Metal: Same kind and form of metal as indicated for louver to which screens are attached. Reinforce extruded-aluminum screen frames at corners with clips.
2. Finish: Same finish as louver frames to which louver screens are attached.
3. Type: Rewirable frames with a driven spline or insert.

D. Louver Screening for Aluminum Louvers:

1. Bird Screening: Aluminum, 1/2-inch- square mesh, 0.063-inch wire.
2. Insect Screening: Aluminum, 18-by-16 mesh, 0.012-inch wire.

2.5 FINISHES

A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish louvers after assembly.

C. High-Performance Organic Finish: 3-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 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: Custom metallic color as selected by Architect.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and openings, with Installer present, 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 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.

3.3 INSTALLATION

- A. Locate and place louvers and vents 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 will be 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 Division 07 Section "Joint Sealants" for sealants applied during louver installation.

3.4 ADJUSTING AND CLEANING

- A. Test operation of adjustable louvers and adjust as needed to produce fully functioning units that comply with requirements.
- B. Clean exposed surfaces of louvers and vents that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.

- C. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.
- D. Restore louvers and vents damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by 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

SECTION 09 01 60 - REFINISHING OF WOOD ATHLETIC FLOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Refinishing wood athletic floors including stripping and applying 3 coats of polyurethane finish with game lines.

1.2 REFERENCES

A. Maple Flooring Manufacturers Association:

1. MFMA - MFMA Guide Specifications.

1.3 SUBMITTALS

A. Product Data: Submit data for each flooring and floor finish material.

B. Shop Drawings:

1. Indicate location, size, design, and color of game markings.

C. Samples:

1. Submit Sample sets showing finishes and game-line and marker paints applied to wood flooring.

D. Submit a detailed refinishing plan including all steps to be undertaken in removing existing finish and applying new finish.

E. Maintenance Data: For wood athletic flooring and finish systems to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with MFMA - Maple Flooring Manufacturers Association.

B. Manufacturer Qualifications: Company specializing in manufacturing refinishing products specified in this section with minimum 10 years experience.

C. Installer Qualifications: Company specializing in performing work of this section with minimum 5 years experience.

1. Installer responsibilities include installation and field finishing of wood athletic flooring components and accessories, and application of game lines and markers.

1.5 ENVIRONMENTAL REQUIREMENTS

A. Refinish floors only when temperature is between 65 and 95 degrees F and humidity is under 80 percent.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Floor Finish: Coliseum 450 low-VOC Oil-Modified Urethane floor coating as manufactured by Buckeye International, Inc.
 - 1. Substitutions: Not allowed.
- B. Game-Line and Marker Paint: Industrial enamel compatible with finish coats and recommended in writing by manufacturers of finish coats, and paint for this use.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Thoroughly examine conditions under which the wood floor system is to be refinished and report any conditions detrimental to proper completion of the work. Do not proceed with installation until detrimental conditions have been corrected.

3.2 PREPARATION

- A. The contractor shall meet at the job site with the wood floor refinisher and the Architect a minimum of one (1) week prior to the wood floor restoration to determine the proper time and conditions for the work.
 - 1. Mask off adjacent surfaces before beginning refinishing.
 - 2. Remove the base shoe as needed.
 - 3. Vacuum and/or sweep the floor clean before stripping.
 - 4. Cover doorways, heat registers, returns, appliances, cabinets, and windows in work area. Cover windows to keep out direct sunlight.
 - 5. Inspect the floor carefully. Identify protruding nail heads or staples. Set nails as necessary.

3.3 REFINISHING

- A. Follow applicable recommendations in MFMA's "Industry Recommendations for Sanding, Sealing, Court Lining, Finishing, and Resurfacing of Maple Gym Floors."
- B. Mask off adjacent surfaces before beginning refinishing operations.
- C. Strip existing floor finish in accordance with floor finish manufacturer's instructions, sweep and clean thoroughly, and allow to dry.
- D. Apply three finish coats in accordance with manufacturer's instructions:
 - 1. Apply first coat, allow to dry, then buff lightly with steel wool to remove irregularities. Vacuum clean and wipe with damp cloth before applying succeeding coat.
 - 2. Apply second coat. Allow to dry. Buff lightly with steel wool.
 - 3. Apply colored game lines to approved layout.
 - 4. Apply last coat of finish.

3.4 CLEANING

- A. Clean and polish floor surfaces in accordance with manufacturer's instructions.

3.5 PROTECTION OF INSTALLED CONSTRUCTION

- A. Prohibit traffic on floor finish for 48 hours after installation.
- B. Protect installed flooring with sheets of hardboard on kraft paper.

END OF SECTION

SECTION 09 05 61 - COMMON WORK RESULTS FOR FLOORING PREPARATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Preparation work for all concrete slabs receiving the following types of floor coverings:
 - a. Carpeting
 - b. Resilient flooring.
 - c. Porcelain tile.

B. Work of this Section includes:

1. Removal of existing floor coverings, if necessary.
2. Preparation of concrete slabs for installation of new floor coverings.
3. Testing of concrete floor slabs for moisture and alkalinity (pH).
4. Testing of concrete floor slabs for adhesive compatibility and bond.
5. Remediation of concrete floor slabs due to unsatisfactory moisture or alkalinity (pH) conditions.
 - a. Contractor shall perform all necessary remediation. A contract modification will be issued for remediation due to conditions not under Contractor's control or that could not have been predicted by visual examination.

1.2 SUBMITTALS

A. Visual Observation Report: For existing floor coverings to be removed.

B. Product Data: For each preparation and remediation product used, including:

1. Manufacturer's qualification statement.
2. Test reports indicating compliance with specified performance requirements, performed by nationally recognized independent testing agency.
3. Manufacturer's installation instructions.
4. Specimen Warranty: Copy of warranty(s) to be issued.

C. Moisture and Alkalinity Testing Agency's Report:

1. Description of areas tested; include floor plans and photographs if helpful.
2. Summary of conditions encountered.
3. Moisture and alkalinity (pH) test reports.
4. Copies of specified test methods.
5. Recommendations for remediation of unsatisfactory surfaces.
6. Submit report to Architect.
7. Submit report not more than two business days after conclusion of testing.

D. Bond and Compatibility Test Report: 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.

1.3 QUALITY ASSURANCE

- A. Moisture and alkalinity (pH) testing shall be performed by an independent testing agency employed and paid by Contractor.
- B. Contractor may perform adhesive compatibility and bond test with his own personnel or hire a testing agency.
- C. 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.
- D. 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 Architect when specified ambient conditions have been achieved and when testing will start.
- E. Flooring Preparation/Installation Qualifications: Company specializing in performing the work of this section, trained by or employed by product manufacturer, and able to provide at least 3 project references showing at least 3 years' experience installing moisture remediation and flooring preparation products.

1.4 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.

1.5 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 or more than 85 degrees F.
- 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.

1.6 WARRANTY

- A. Individual Product Warranties: For each individual product installed, provide Uzin Utz North America's Limited 10-Year Warranty covering the cost of repair or replacement of defective material and related floor covering.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

- B. System Warranty for Resilient Vinyl Tile: Where two or more products are installed together under resilient vinyl tile floor covering, provide Uzin Utz North America's Classic Plus +10 System Warranty covering the cost of repair or replacement of defective materials and related floor covering.
 - 1. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Basis-of-Design: Subject to compliance with requirements, provide Uzin products manufactured by Uzin Utz North America, Inc.; www.uzin.com, or comparable products with comparable system warranty by alternate manufacturer including, but not limited to, the following:
 - 1. Mapei
 - 2. Sika

2.2 MATERIALS

- A. Patching Compound: Manufacturer's recommended product, suitable for conditions, and compatible with adhesive and floor covering. In the absence of any recommendation from flooring manufacturer, with the following characteristics:
 - 1. Cementitious moisture-, mildew-, and alkali-resistant compound, compatible with floor, floor covering, and floor covering adhesive, and capable of being feathered to nothing at edges.
 - 2. Latex or polyvinyl acetate additions are permitted; gypsum content is prohibited.
 - 3. Compressive Strength: 3000 psi, minimum, after 28 days, when tested in accordance with ASTM C109/C109M or ASTM C472, whichever is appropriate.
- B. 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.
- C. Self-Leveling Underlayment: Hydraulic-cement-based, polymer-modified, self-leveling product that can be applied in minimum uniform thicknesses of 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 by ASTM C 219.
 - 2. Compressive Strength: Not less than 4100 psi at 28 days when tested according to ASTM C 109/C 109M.
 - 3. Underlayment Additive: Resilient-emulsion product of underlayment manufacturer formulated for use with underlayment when applied to substrate and conditions indicated.
 - 4. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch; or coarse sand as recommended by underlayment manufacturer.
 - a. Provide aggregate when recommended in writing by underlayment manufacturer for underlayment thickness required.
- D. Primer: Product of underlayment or remedial floor coating manufacturer recommended in writing for substrate, conditions, and application indicated.

- E. Flooring Adhesive: Manufacturer's recommended product, suitable for the moisture and pH conditions present; low-VOC. For use with resilient vinyl tile, adhesive shall be type required to achieve Uzin Utz Classic + 10 warranty, or comparable by selected manufacturer.

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.
 - 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 and one test in each additional 1000 square feet, 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. Moisture or alkalinity remediation, if required.
 - 8. Patching, smoothing, and leveling, as required.
 - 9. Adhesive bond and compatibility test.
 - 10. 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 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 REMOVAL OF EXISTING FLOOR COVERINGS

- A. Comply with local, State, and federal regulations and recommendations of RFCI Recommended Work Practices for Removal of Resilient Floor Coverings, as applicable to floor covering being removed.

- B. Dispose of removed materials in accordance with local, State, and federal regulations and as specified.

3.3 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.

3.4 MOISTURE VAPOR EMISSION TESTING

- A. Where the floor covering or floor preparation 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.
 - 1. 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.
 - 2. 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 per 24 hours.
- D. Report: Report the information required by the test method.

3.5 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.
 - 1. 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.
 - 2. 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.
- D. Report: Report the information required by the test method.

3.6 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.
- C. Use a wide range alkalinity (pH) test paper, its associated chart, and distilled or deionized water.
- D. Place several drops of water on a clean surface of concrete, forming a puddle approximately 1 inch 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.
- 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 alkalinity (pH) test value is over 10.

3.7 PREPARATION

- A. See individual floor covering section(s) for additional requirements.
- B. Comply with requirements and recommendations of floor covering manufacturer.
- C. Fill and smooth surface cracks, grooves, depressions, control joints and other non-moving joints, and other irregularities with patching compound.
- D. Do not fill expansion joints, isolation joints, or other moving joints.

3.8 ADHESIVE BOND AND COMPATIBILITY TESTING

- A. Comply with requirements and recommendations of floor covering manufacturer.

3.9 APPLICATION OF REMEDIAL FLOOR COATING

- A. Comply with requirements and recommendations of coating manufacturer.

3.10 PROTECTION

- A. Cover prepared floors with building paper or other durable covering.

END OF SECTION

SECTION 09 21 16 - GYPSUM BOARD ASSEMBLIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Performance criteria for gypsum board assemblies.
- B. Gypsum wallboard.
- C. Impact Resistant (Abuse Resistant) Gypsum wallboard
- D. Joint treatment and accessories.

1.2 SUBMITTALS

- A. Product Data: Provide data on metal framing, gypsum board, glass mat faced gypsum board, accessories, joint finishing system, and pre-engineered ceiling suspension system.
- B. Certification: Manufacturer's affidavit that materials used contain no asbestos.

1.3 QUALITY ASSURANCE

- A. Maintain one copy of all installation standards at project site.
- B. Installer Qualifications: Company specializing in performing gypsum board application and finishing, with minimum 5 years of documented experience.

1.4 SPECIAL WARRANTY

- A. In addition to the standard warranty, provide warranty from the manufacturer for the following products:
 - 1. Glass-mat Interior panel weathering warranty covering in-place exposure damage to sheathing for 6 months.
 - 2. Glass-mat sheathing warranty against manufacturing defects for 5 years.
 - 3. Tile backer board warranty against manufacturing defects for 20 years.

PART 2 - PRODUCTS

2.1 GYPSUM BOARD ASSEMBLIES

- A. Provide completed assemblies complying with ASTM C 840 and GA-216.
 - 1. See PART 3 for finishing requirements.
- B. Fire Rated Assemblies: Provide completed assemblies complying with applicable code.
 - 1. ICC IBC Item Numbers: Comply with applicable requirements of ICC IBC for the particular assembly.

2. Gypsum Association File Numbers: Comply with requirements of GA-600 for the particular assembly.
3. UL Assembly Numbers: Provide construction equivalent to that listed for the particular assembly in the current UL Fire Resistance Directory.
4. Deflection Track and Firestop System (At fire rated walls): Contractor shall use a deflection track and firestop system at heads of fire rated partitions. System shall use "Shadowline" deflection track, mineral fiber, sealant, clips, and accessories required to achieve fire ratings shown or required by authorities having jurisdiction. System shall comply with Deflection Track and Firestop System manufactured by Fire Trak Corp., Kimball, MN; (800) 394-9875, or Architect approved equal.

2.2 METAL FRAMING MATERIALS

- A. Non-Loadbearing Studs, Ceiling Framing, and Furring for Application of Gypsum Board: As specified in Section 09 22 16.
- B. Loadbearing Studs for Application of Gypsum Board: As specified in Section 05 40 00.

2.3 GYPSUM BOARD MATERIALS

- A. Manufacturers - Gypsum-Based Board:
 1. American Gypsum C.: www.americangypsum.com
 2. Georgia-Pacific Gypsum LLC: www.gp.com/gypsum.
 3. National Gypsum Company: www.nationalgypsum.com.
 4. USG Corporation: www.usg.com.
- B. Gypsum Wallboard: ASTM C 1396/C 1396M. Sizes to minimize joints in place; ends square cut.
 1. Fire Resistant Type: Complying with Type X requirements; UL or WH rated.
 - a. Thickness: 5/8 inch.
 - b. Edges: Tapered.
- C. Water-Resistant Gypsum Board: ASTM C 1396/C 1396M; ends square cut.
 1. Application: Vertical surfaces in wet areas without tile.
 2. Core Type: Regular and Type X, as indicated.
 3. Thickness: 5/8 inch, as indicated.
 4. Edges: Tapered.
 5. Product: DensShield Glass-mat Board manufactured by G-P Gypsum Corporation.
- D. Tile Backer Board: See Section 09 30 00.
- E. Impact Resistant (Abuse-Resistant) Gypsum Board: ASTM C 1629/C 1629M, Level 3.
 1. Core: 5/8 inch, Type X.
 2. Long Edges: Tapered.
 3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

2.4 ACCESSORIES

- A. Outside Corner Beads:
 1. Square: No. 28 gauge (0.012 inch) galvanized steel, 1-1/4 inch legs.

- B. Edge Trim: J-Mold (Casing Bead) No. 28 gauge (0.012 inch) galvanized steel by 5/8 inch wide.
- C. Control Joint: zinc, 1/4 inch by 7/16 inch deep joint protected by removable tape
- D. Reveals: Subject to compliance with requirements, provide aluminum gypsum board trim and reveals as indicated on drawings and manufactured by one of the following, or approved equal:
 - 1. Flannery, Inc.
 - 2. Fry Reglet Corporation
 - 3. Superior Metal Trim
- E. Acoustic Insulation: As specified in Section 07 21 00.
- F. Acoustic Sealant: As specified in Section 07 90 05.
- G. Water-Resistive Barrier: No. 15 asphalt felt.
- H. Finishing Accessories: ASTM C 1047, galvanized steel or rigid plastic, unless otherwise indicated.
 - 1. Types: As detailed or required for finished appearance.
 - 2. Special Shapes: In addition to conventional cornerbead and control joints, provide U-bead at exposed panel edges.
- I. Joint Materials: ASTM C 475 and as recommended by gypsum board manufacturer for project conditions.
 - 1. Tape: 2 inch wide, creased paper tape for joints and corners, except as otherwise indicated.
 - 2. Tape: 2 inch wide, coated glass fiber tape for use where indicated.
 - 3. Ready-mixed vinyl-based joint compound.
- J. High Build Drywall Surfer: Vinyl acrylic latex-based coating for spray application, designed to take the place of skim coating and separate paint primer in achieving Level 5 finish.
- K. Screws: ASTM C 954; steel drill screws for application of gypsum board to loadbearing steel studs.
- L. Laminating Adhesives: Standard type manufactured or recommended by manufacturer of product to be laminated.
- M. Ceiling Hanger and Tie Wire: 9-gauge galvanized hanger wire and 16 gauge tie wire.
- N. Resilient Clips: Standard type for resilient installation in accordance with wallboard manufacturer's instructions.
- O. Wall Fixture Reinforcement: 6 inches, 14 gauge cold rolled steel galvanized channels.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that project conditions are appropriate for work of this section to commence.

3.2 FRAMING INSTALLATION - SEE SECTION 09 22 16

3.3 ACOUSTIC ACCESSORIES INSTALLATION

- A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.
- B. Acoustic Sealant: Install in accordance with manufacturer's instructions.
 - 1. Place one bead continuously on substrate before installation of perimeter framing members.
 - 2. Place continuous bead at perimeter of each layer of gypsum board.
 - 3. In non-fire-rated construction, seal around all penetrations by conduit, pipe, ducts, and rough-in boxes.

3.4 COMMENCEMENT RESTRICTIONS

- A. Interior gypsum wallboard and ceiling board installation may not commence until all exterior dampproofing and roofing are completed and roof top equipment is fully installed and flashed and exterior wall openings are protected, except when using Glass-mat Interior Panels.

3.5 BOARD AND GLASS MAT FACED BOARD INSTALLATION

- A. Comply with ASTM C 840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.
 - 1. Install gypsum board 1/2 inch above surface of slab to prevent wicking of moisture.
- B. Single-Layer Non-Rated: Install gypsum board in most economical direction, with ends and edges occurring over firm bearing.
 - 1. Exception: Tapered edges to receive joint treatment at right angles to framing.
- C. Double-Layer Non-Rated: Use gypsum board for first layer, placed parallel to framing or furring members, with ends and edges occurring over firm bearing. Place second layer perpendicular to framing or furring members. Offset joints of second layer from joints of first layer.
- D. Fire-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.
- E. Glass Mat Faced Gypsum Board: Install in strict accordance with manufacturer's instructions.
- F. Installation on Metal Framing: Use screws for attachment of all gypsum board except face layer of non-rated double-layer assemblies, which may be installed by means of adhesive lamination.
- G. Curved Surfaces: Apply gypsum board to curved substrates in accordance with GA-226.
- H. Moisture Protection: Treat cut edges and holes in moisture resistant gypsum board with sealant.
- I. On all fire rated walls, wall rating shall be stenciled above ceiling per fire marshal's requirement.

3.6 INSTALLATION OF TRIM AND ACCESSORIES

- A. Control Joints: Place control joints consistent with lines of building spaces and as indicated.
 - 1. Not more than 30 feet apart on walls and ceilings over 50 feet long.
 - 2. At exterior soffits, not more than 30 feet apart in both directions.
 - 3. Control joints shall consist of non-connected back to back studs at each joint.
- B. Corner Beads: Install at external corners, using longest practical lengths. At corridor intersections, wall assemblies shall be recessed to allow for flush mounted corner guards
- C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials and as indicated.

3.7 JOINT TREATMENT

- A. Glass Mat Faced Gypsum Board: Use fiberglass joint tape, bedded and finished with chemical hardening type joint compound.
- B. Paper Faced Gypsum Board: Use paper joint tape, bedded with ready-mixed vinyl-based joint compound and finished with ready-mixed vinyl-based joint compound.
- C. Never place a butt end or a cut edge next to a tapered or rounded edge. Wherever possible, apply boards perpendicular to framing and in lengths that will span ceilings and walls without creating end (butt) joints. If butt joints do occur, stagger and locate them as far from the center of walls and ceilings as possible.
- D. Finish gypsum board in scheduled areas in accordance with levels defined in GA-214 and as scheduled below:
 - 1. Wall Areas Above Finished Ceilings Concealed From View: Level 1.
 - 2. Utility Areas and Areas Behind Cabinetry: Level 2.
 - 3. Walls to Receive Textured Wall Finish: Level 3.
 - 4. Walls and Ceilings to Receive Flat or Eggshell Paint Finish: Level 4.
 - 5. Walls and Ceilings to Receive Semi-Gloss or Gloss Paint Finish: Level 5.
 - 6. Temporary partitions and surfaces indicated to be finished in later stage of project: Level 0
- E. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
 - 1. Feather coats of joint compound so that camber is maximum 1/32 inch.
- F. Where Level 5 finish is indicated, spray apply high build drywall surfacer over entire surface after joints have been properly treated; achieve a flat and tool mark-free finish.
- G. Fill and finish joints and corners of cementitious backing board as recommended by manufacturer.

3.8 TOLERANCES

- A. Visual: Correct any nicks, bumps, out-of-level or out-of-plumb areas detectable to the naked eye.

- B. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.
- C. Bumps in Boards: Maximum 1/8 inch in 24 inches.
- D. Corners: Maximum out-of-square 1/8 inch in 16 inches.
- E. Float solid between corner beads less than 36 inches apart. Surfaces that appear concave are not acceptable.

END OF SECTION

SECTION 09 22 16 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Metal partition, ceiling, and soffit framing for interior partitions, ceilings; exterior non-wind-load-resisting, and non-load-bearing walls.
- B. Framing accessories.

1.2 SUBMITTALS

- A. Product Data: Provide data describing framing member materials and finish, product criteria, load charts, and limitations.
- B. Product Data: Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.
- C. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing the work of this section with minimum 5 years experience.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Metal Framing, Connectors, and Accessories:
 - 1. ClarkDietrich: www.clarkdietrich.com.
 - 2. MarinoWare: www.marinoware.com.
 - 3. National Gypsum Company.
 - 4. Dale Industries, Inc.
 - 5. Substitutions: See Section 01 25 00 - Substitution Procedures.

2.2 FRAMING MATERIALS

- A. Non-Loadbearing Framing System Components: ASTM C 645; galvanized sheet steel, of size and properties necessary to comply with ASTM C 754 for the spacing indicated, with maximum deflection of wall framing of L/240 at 5 psf. Studs supporting ceramic tile shall have maximum deflection of L/360.

1. Exception: The minimum metal thickness and section properties requirements of ASTM C 645 are waived provided steel of 40 ksi minimum yield strength is used, the metal is continuously dimpled, the effective thickness is at least twice the base metal thickness, and maximum stud heights are determined by testing in accordance with ASTM E 72 using assemblies specified by ASTM C 754.
 - a. Acceptable Products:
 - 1) Dietrich Metal Framing; UltraSteel (tm): www.dietrichindustries.com.
 - 2) Clark Western Building Systems; UltraSteel (tm): www.clarkwestern.com.
 2. Studs: C shaped with flat or formed webs with knurled faces, formed from 20 gauge galvanized steel, unless shown otherwise on drawings. Provide channel type screw studs roll formed from 20 gauge galvanized steel at walls to receive tile.
 3. Runners: U shaped, sized to match studs.
 4. Ceiling Channels: C shaped.
 5. Furring: Hat-shaped sections, minimum depth of 7/8 inch.
- B. Loadbearing Studs: As specified in Section 05 40 00.
- C. Ceiling Hangers: Type and size as specified in ASTM C 754 for spacing required.
- D. Shaft Wall Studs and Accessories: ASTM C 645; galvanized sheet steel, of size and properties necessary to comply with ASTM C 754.
- E. Gypsum Board Ceiling Hangers: Type and size as specified in ASTM C 754 for spacing required.
1. Contractor's Option: Pre-engineered drywall suspension system specially created to simplify the design and construction of flat drywall ceilings.
 - a. Approved Product/Manufacturer: USG Drywall Suspension System manufactured by USG Interiors, Inc., or Architect approved equal.
- F. Partition Head to Structure Connections: Provide mechanical anchorage devices that accommodate deflection using slotted holes, screws and anti-friction bushings, preventing rotation of studs while maintaining structural performance of partition.
1. Structural Performance: Maintain lateral load resistance and vertical movement capacity required by applicable code, when evaluated in accordance with AISI North American Specification for the Design of Cold-Formed Steel Structural Members.
 2. Material: ASTM A 653/A 653M steel sheet, SS Grade 50, with G60/Z180 hot dipped galvanized coating.
 3. Provide components UL-listed for use in UL-listed fire-rated head of partition joint systems indicated on drawings.
 4. Provide top track preassembled with connection devices spaced to fit stud spacing indicated on drawings; minimum track length of 12 feet.
- G. Tracks and Runners: Same material and thickness as studs, bent leg retainer notched to receive studs with provision for crimp locking to stud.
- H. Furring and Bracing Members: Of same material as studs; thickness to suit purpose; complying with applicable requirements of ASTM C 754.
- I. Fasteners: ASTM C 1002 self-piercing tapping screws.
- J. Powder-Driven Fasteners: 0.300 inch Headed Fasteners with 0.145 inch Shank Diameter
- K. Sheet Metal Backing: 0.036 inch thick, galvanized.

- L. Anchorage Devices: Power actuated.
- M. Acoustic Insulation: As specified in Section 07 21 00.
- N. Acoustic Sealant: As specified in Section 09 21 16.
- O. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic.

2.3 FABRICATION

- A. Fabricate assemblies of framed sections to sizes and profiles required.
- B. Fit, reinforce, and brace framing members to suit design requirements.
- C. Fit and assemble in largest practical sections for delivery to site, ready for installation.

PART 3 - EXECUTION

3.1 INSTALLATION OF STUD FRAMING

- A. Comply with requirements of ASTM C 754.
- B. Extend partition framing to structure where indicated and to ceiling in other locations.
- C. Partitions Terminating at Ceiling: Attach ceiling runner securely to diagonal wall bracing at 48 inches on center staggered and anchored at structure above as detailed on the drawings.
- D. Partitions Terminating at Structure: Attach top runner to structure, maintain 1/2 inch clearance between top of studs and structure, and connect studs to track using specified mechanical devices in accordance with manufacturer's instructions; verify free movement of top of stud connections; do not leave studs unattached to track. Do not fasten studs directly to deflection track. At fire rated walls, use the specified deflection track with firestop systems.
- E. Align and secure top and bottom runners at 24 inches on center.
- F. At partitions indicated with an acoustic rating:
 - 1. Place one bead of acoustic sealant between runners and substrate, studs and adjacent construction.
 - 2. Place one bead of acoustic sealant between studs and adjacent vertical surfaces.
- G. Fit runners under and above openings; secure intermediate studs to same spacing as wall studs.
- H. Install studs vertically at 16 inches on center, unless noted otherwise.
- I. Align stud web openings horizontally.
- J. Secure studs to tracks using crimping method. Do not weld.
- K. Stud splicing is not permissible.

- L. Openings: Reinforce openings as required for weight of doors or operable panels, using not less than double studs at jambs, sills, and heads. Provide stud box beams at the head and sill of openings as indicated.
- M. Fabricate corners using a minimum of three studs.
- N. Double stud at wall openings, door and window jambs, heads, and sills, not more than 2 inches from each side of openings.
- O. Standard Wall Furring: Install at concrete and masonry walls scheduled to receive gypsum board, not more than 4 inches from floor and ceiling lines and abutting walls. Secure in place on alternate channel flanges at maximum 24 inches on center.
 - 1. Orientation: Horizontal.
- P. Acoustic Furring: Install resilient channels at maximum 24 inches on center. Locate joints over framing members.
- Q. Brace stud framing system rigid to structure above as indicated.
- R. Coordinate erection of studs with requirements of door frames and window frames; install supports and attachments.
- S. Coordinate installation of bucks, anchors, and blocking with electrical, mechanical, and other work to be placed within or behind stud framing.
- T. Use sheet metal backing or wood blocking for reinforcement of wall mounted fixtures and accessories.
- U. At corridor intersections, wall assemblies shall be recessed to allow for flush mounted corner.

3.2 CEILING AND SOFFIT FRAMING

- A. Comply with requirements of ASTM C 754 and manufacturer's instructions.
 - 1. Contractor's Option: Install ceiling drywall suspension system in accordance with manufacturer's instructions.
- B. Install furring after work above ceiling or soffit is complete. Coordinate the location of hangers with other work.
- C. Install furring independent of walls, columns, and above-ceiling work.
- D. Securely anchor hangers to structural members or embed in structural slab. Space hangers as required to limit deflection to criteria indicated.
- E. Use rigid hangers at exterior soffits to resist wind uplift.
- F. Space main carrying channels at maximum 48 inch on center, and not more than 6 inches from wall surfaces. Lap splice securely.
- G. Securely fix carrying channels to hangers to prevent turning or twisting and to transmit full load to hangers.

- H. Place furring channels perpendicular to carrying channels, not more than 2 inches from perimeter walls, and rigidly secure. Lap splices securely.
- I. Reinforce openings in suspension system that interrupt main carrying channels or furring channels with lateral channel bracing. Extend bracing minimum 24 inches past each opening.
- J. Laterally brace entire suspension system.
- K. Level ceiling and soffit system to a tolerance of 1/1200.

3.3 TOLERANCES

- A. Maximum Variation From True Position: 1/8 inch in 10 feet.
- B. Maximum Variation From Plumb: 1/8 inch in 10 feet.

END OF SECTION

SECTION 09 24 00 - PORTLAND CEMENT PLASTERING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Portland cement plaster for installation over metal lath.

1.2 RELATED REQUIREMENTS

- A. Section 05 40 00 - Cold-Formed Metal Framing: Structural metal framing for plaster.
- B. Section 09 22 16 - Non-Structural Metal Framing: Metal stud framing and furring for plaster.
- C. Section 09 22 36.23 - Metal Lath: Metal furring and lathing for plaster.
- D. Section 09 21 16 - Gypsum Board Assemblies: Exterior sheathing.

1.3 SUBMITTALS

- A. Product Data: Provide data on plaster materials, characteristics and limitations of products specified.
- B. Samples: Submit two samples of each texture requested by Architect, 12 by 12 inch in size illustrating finish color and texture.
- C. Mix Design: Provide data conforming to specified requirements.
- D. Certification: Manufacturer's affidavit that materials used on Project contain no asbestos.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with ASTM C 926.
 - 1. Maintain one copy on site.
- B. Installer Qualifications: Company specializing in performing the work of this section with minimum 5 years of experience.

1.5 MOCK-UP

- A. Locate where directed.
- B. Mock-up may not remain as part of the Work.

1.6 FIELD CONDITIONS

- A. Do not apply plaster when substrate or ambient air temperature is under 50 degrees F or over 80 degrees F, except as indicated below.

- B. Maintain minimum ambient temperature of 50 degrees F during installation of plaster and until cured.

PART 2 - PRODUCTS

2.1 PLASTER MATERIALS

- A. Portland Cement, Aggregates, and Other Materials: In accordance with ASTM C 926.
- B. Portland Cement: ASTM C 150, Type I.
 - 1. For finish coat: White color.
- C. Masonry Cement: ASTM C 91 Type N.
- D. Lime: ASTM C 206, Type S.
- E. Aggregate: In accordance with ASTM C 926.
- F. Water: Clean, fresh, potable and free of mineral or organic matter that could adversely affect plaster.
- G. Plaster Mix Reinforcement: Glass fibers, chopped to 1/2 inch nominal length, alkali resistant.
- H. Color Pigment: Mineral oxide type, color as selected.

2.2 METAL LATH

- A. Metal Lath and Accessories: As specified in Section 09 22 36.23.
- B. Beads, Screeds, and Joint Accessories: As specified in Section 09 22 36.23.

2.3 PLASTER MIXES

- A. Over Metal Lath: Three-coat application, mixed and proportioned in accordance with ASTM C 926.
- B. First Coat: Plaster Mix CM
 - 1. One part Portland cement.
 - 2. Minimum 1 and maximum 2 parts masonry cement.
 - 3. Minimum 2-1/2 and maximum 4 parts aggregate, per sum of cementitious materials.
 - 4. Reinforcement at 1-1/2 lbs per sack of cement.
- C. Second Coat: Same as first coat, except minimum 3 parts and maximum 5 parts aggregate. Add integral liquid or powdered waterproofing in accordance with manufacturer's instructions.
- D. Finish Coat: Plaster Mix F (Soffits only)
 - 1. One part portland cement.
 - 2. Minimum 3/4 and maximum 1-1/2 parts lime.
 - 3. 3 parts sand, per sum of cementitious materials.

- E. Acrylic Finish Coat: Texture to be selected by Architect, by one of the following manufacturer's:
 - 1. Dryvit Systems, Inc., West Warwick, RI; (800) 556-7752
 - 2. Finestone, Div. of Simplex Products, Jacksonville, FL; (866) 659-3133
 - 3. Parex, Inc., Redan, GA; (800) 537-2739
 - 4. Senergy, LLC / BASF, Jacksonville, FL; (866) 221-9255
 - 5. Sto Finish Systems Div., Sto Corp., Atlanta, GA; (800) 221-2397
 - 6. TEIFS, San Antonio, TX; (800) 358-4785
- F. Mix only as much plaster as can be used prior to initial set.
- G. Add color pigments to finish coat in accordance with manufacturer's instructions.
- H. Mix materials dry, to uniform color and consistency, before adding water.
- I. Protect mixtures from freezing, frost, contamination, and excessive evaporation.
- J. Do not retemper mixes after initial set has occurred.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify the suitability of existing conditions before starting work.
- B. Metal Lath and Accessories: Verify lath is flat, secured to substrate, and joint and surface perimeter accessories are in place.

3.2 PLASTERING

- A. Apply plaster in accordance with ASTM C 926.
- B. Apply plaster in accordance with ASTM C 926.
- C. Thickness:
 - 1. Vertical: 7/8 inch
 - 2. Horizontal: 3/4 inch
- D. Cold Weather:
 - 1. Do not use frozen material.
 - 2. Do not apply cement plaster to frozen surfaces or surfaces containing frost.
 - 3. Do not mix materials or apply cement plaster when ambient temperature is less than 50 degrees F.
 - 4. A temperature of at least 55 degrees F must be maintained prior to plaster application, during its application, and until it is dry. Plaster work which freezes within 48 hours of application shall be removed and replaced with new plaster.
- E. Hot Weather:
 - 1. Protect cement plaster from uneven and excessive evaporation during hot, windy, and dry weather.

2. Moist curing after each coat of cement plaster with water if ambient temperature is more than 75 degrees F. Moist cure for 48 hours after application of coats.
 3. During hot, or dry, or windy weather, the cement plaster should be moistened down and then covered with a single sheet of polyethylene plastic (clear only).
 4. Moist curing is required at the start and end of work day.
 5. Humidity higher than 75 percent. Moist curing not required.
- F. In exterior work, scribe contraction joints through entire plaster application at 10 feet on center each way and as shown on drawings.
- G. Moist cure base coats.
- H. Apply second coat immediately following initial set of first coat.
- I. After curing, dampen previous coat prior to applying finish coat.
- J. Avoid excessive working of surface. Delay troweling as long as possible to avoid drawing excess fines to surface.
- K. Moist cure finish coat for minimum period of 48 hours.
- 3.3 TOLERANCES
- A. Maximum Variation from True Flatness: 1/8 inch in 10 feet.

END OF SECTION

SECTION 09 30 00 - TILING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Tile for floor applications.
- B. Tile for wall applications.
- C. Cementitious backer board as tile substrate.
- D. Coated glass mat backer board as tile substrate.
- E. Stone thresholds.
- F. Tile Trim and Edge Treatment

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.
- B. Refer to drawings for Finish Schedule.

1.3 SUBMITTALS

- A. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.
- B. Samples: Mount tile and apply grout on two plywood panels, minimum 18 x 18 inches in size illustrating pattern, color variations, and grout joint size variations.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Maintenance Data: Include recommended cleaning methods, cleaning materials, stain removal methods, and polishes and waxes.
- E. Shop drawings: Indicate patterns, color arrangement, perimeter conditions, junctions with dissimilar materials, setting details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces..

1.4 QUALITY ASSURANCE

- A. Maintain one copy of TCNA Handbook, and ANSI A108 Series and A118 Series on site.
- B. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, with minimum 5 years of documented experience.
- C. Installer Qualifications: Company specializing in performing tile installation, with minimum of 5 years of documented experience.

- D. Tile that is warped more than 1/8 inch in any direction will be replaced prior to installation at no cost to the Owner.

1.5 MOCK-UP

- A. See Section 01 40 00 - Quality Requirements, for general requirements for mock-up.
- B. Construct tile mock-up in location directed by Architect, incorporating all components specified for the location.
 - 1. Minimum size of mock-up 60 inches by 60 inches.
 - 2. Owner and Architect to approved mock-up prior to beginning of work.

1.6 FIELD CONDITIONS

- A. Do not install adhesives in an unventilated environment.
- B. Maintain ambient and substrate temperature of 50 degrees F minimum during installation of mortar materials.

1.7 EXTRA MATERIALS

- A. Deliver extra materials to Owner. Furnish extra materials in the amount of 3 unopened boxes of each color and base, and size indicated from the same tile run as installed.

PART 2 - PRODUCTS

2.1 TILE

- A. Manufacturers - All products by the same manufacturer, except as noted on Schedule:
 - 1. Refer to drawings for Finish Schedule.
 - 2. Substitutions: Not permitted.
- B. Porcelain Paver Tile: ANSI A137.1, and as follows:
 - 1. Size and Shape: As scheduled.
 - 2. Edges: Rectified.
 - 3. Surface Finish: Unglazed.
 - 4. Colors: As scheduled.
 - 5. Coefficient of Friction: #3 > 0.60 wet
 - 6. Manufacturers:
 - a. Dal-Tile Corp.
 - b. Americal Marazzi Tile
 - c. Crossville Ceramics Co.
 - d. Interceramic
- C. Ceramic Tile: ANSI A137.1, and as follows:
 - 1. Size and Shape: As scheduled
 - 2. Edges: Cushioned.
 - 3. Surface Finish: Unglazed for floor tile, glazed/matte for wall tile.
 - 4. Colors: As scheduled.
 - 5. Manufacturers:

- a. Dal-Tile Corp.
- b. Americal Marazzi Tile
- c. Crossville Ceramics Co.
- d. Interceramic

D. Quarry Tile: ANSI A137.1, and as follows:

1. Size and Shape: As scheduled
2. Edges: Cushioned.
3. Surface Finish: ribbed.
4. Colors: As scheduled.
5. Manufacturers:
 - a. American Olean Tile Co. , Sure-Step
 - b. Dal-Tile Corp., Suretread
 - c. Metropolitan Ceramics, Metrotread
 - d. Summitville Tiles, Inc.

2.2 TRIM AND ACCESSORIES

A. Ceramic Trim: Matching cove base ceramic shapes in sizes indicated.

1. Manufacturer: As scheduled.
2. Base: size and shape as scheduled, mitered corners, special shapes for internal/external corners
3. Bull nose pieces will be used on all outside corners.
4. Use uncoupling membrane or flush transitions at all cold joints/expansion joints in concrete slab.

B. Thresholds: Marble, white or gray, honed finish; 2 inches wide by full width of wall or frame opening; 3/8 inch thick; square on top side; without holes, cracks, or open seams.

1. Applications: Provide at the following locations:
 - a. At doorways where tile terminates.
 - b. At open edges of floor tile where adjacent finish is a different height.

C. Transitions: Schluter – Schiene aluminum strip between tile and carpet. Schluter – RENO-U aluminum strip between tile and sealed concrete.

2.3 MORTAR MATERIALS

A. Manufacturers:

1. Laticrete International; Laticrete LHT Plus Mortar: www.laticrete.com.
2. Mapei Corp.; Mapei Keraflex Plus Mortar

B. Mortar Bed Materials: Portland cement, sand, latex additive and water.

C. Mortar Bond Coat Materials:

1. Dry-Set Portland Cement type: ANSI A118.1.
2. Latex-Portland Cement type: ANSI A118.11.
3. Epoxy: ANSI A118.3.

D. Glass Tile Mortar: Laticrete #255 Max White; or Mapei Adesilex P10

2.4 GROUT MATERIALS

- A. Epoxy Grout: ANSI A118.3, 100% solids epoxy grout; use for all applications.
 - 1. Laticrete International; Product Latapoxy 2000 Industrial Epoxy grout.

2.5 ACCESSORY MATERIALS

- A. Cleavage Membrane: 4 mil thick polyethylene film.
- B. Crack Isolation Membrane: reinforced self-adhering elastomeric membrane meeting ANSI A118.12 from one of the following:
 - 1. Mapei; Product Mapeguard 2.
 - 2. The Noble Company; Product Nobleseal CIS.
 - 3. National Applied Construction Products (NAC); Product ECB
- C. Uncoupling Membrane: 1/8 inch thick polyurethane matting with three-dimensional grid structure with dovetail shaped cavities and fleece webbing laminated to the underside to provide a mechanical bond to the substrate adhesive (DITRA).
- D. Waterproofing Membrane (Floor with drains): Fluid applied polymer complying with ANSI A118.10.
 - 1. Product: Hydro Ban manufactured by Laticrete International.
 - 2. Product: Mapelastic Aquadefense by Mapei Corp.
 - 3. Substitutions: See Section 01 60 00 - Product Requirements.
- E. Backing Board For Wet Areas: One of the following products:
 - 1. Application: Surfaces behind tile in wet areas including shower room walls.
 - 2. Cement-Based Board: Non-gypsum-based; aggregated portland cement panels with glass fiber mesh embedded in front and back surfaces complying with ANSI A118.9. Provide membrane behind backer board per TCA W244.
 - a. Thickness: 1/2 inch.
 - b. Products:
 - 1) Custom Building Products; Wonderboard.
 - 2) National Gypsum Company; PermaBase Brand Cement Board.
 - 3) USG Corporation; Durock Brand Cement Board.
 - 3. Glass-Mat-Faced Board: Water-resistant backer board with coated inorganic fiberglass mat on both surfaces and integral acrylic coating vapor retarder as defined in ASTM C 1178.
 - a. Standard Type: Thickness 1/2 inch.
 - b. Fire-Resistant Type: Type X core, thickness 5/8 inch.
 - c. Products:
 - 1) Georgia-Pacific Gypsum LLC; DensShield Backer Board.
- F. Backing Board For Non-Wet Areas: Glass-mat faced water-resistant gypsum backing board as defined in ASTM C 1396/C 1396M; sizes to minimum joints in place; ends square cut.
 - 1. Application: Vertical surfaces behind thinset tile, except in wet areas.
 - 2. Mold Resistance: Score of 10, when tested in accordance with ASTM D 3273.
 - 3. Type: Regular and Type X, in locations indicated.
 - 4. Type X Thickness: 5/8 inch.
 - 5. Regular Board Thickness: 1/2 inch.
 - 6. Edges: Tapered.

7. Products:
- a. CertainTeed Corporation; ProRoc Brand Moisture & Mold Resistant Gypsum Board.
 - b. Georgia-Pacific Gypsum LLC; DensArmor Plus Interior Panels.
 - c. National Gypsum Company; Gold Bond Brand XP Gypsum Board.
 - d. Temple-Inland Inc; ComfortGuard.
 - e. USG Corporation; Sheetrock Brand Mold Tough Gypsum Panels.
 - f. Substitutions: See Section 01 60 00 - Product Requirements.

G. Mesh Tape: 2-inch wide self-adhesive fiberglass mesh tape.

H. Transitions: Schluter – Schiene aluminum strip between tile and carpet. Schluter – RENO-U aluminum strip between tile and sealed concrete.

I. Corner Guards for tile exterior corners other than the kitchen area- Extruded one-piece unit without splices, installed integral with tile.

1. Basis of Design: Schluter – Quadec Q 125E
2. Material: Type 304 stainless steel, No. 4 finish.
3. Styles: Provide 90 degree corners and wall end protectors.
4. Size: 1/2 inch x 1/2 inch x full height of ceiling.
5. Length: One piece.

2.6 SOURCE QUALITY CONTROL

A. Tile that is warped more than 1/8 inch in any direction shall be replaced prior to installation.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that sub-floor 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. Remedy unacceptable floor surfaces with cementitious underlayment when levelness does not meet .
- D. Verify that sub-floor surfaces are dust-free and free of substances that could impair bonding of setting materials to sub-floor surfaces.
- E. Verify that concrete sub-floor surfaces are ready for tile installation by testing for moisture emission rate and alkalinity; obtain instructions if test results are not within the following limits:
 1. Moisture emission rate: Not greater than 3 lb per 1000 sq ft per 24 hours when tested using calcium chloride moisture test kit for 72 hours.
 2. Alkalinity: pH range of 5-9.

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 cementitious backer board in accordance with ANSI A108.11 and board manufacturer's instructions. Tape joints and corners, cover with skim coat of dry-set mortar to a feather edge.
- E. Install tile backer board in strict accordance with manufacturer's instructions, using galvanized roofing nails or corrosion-resistant bugle head drywall screws. Bed fiberglass self-adhesive tape at all joints and corners with material used to set tiles.
- F. Backer Board:
 - 1. Substrate for tile (Dry areas): Apply glass mesh joint tape over joints. Embed tape in setting material specified for tile finishes. Allow joints to dry prior to installing tile systems.
 - 2. Substrate for tile (Wet areas): Apply clear silicone sealant to corners and board joints. Apply glass mesh joint tape over joints. Embed tape in setting material specified for tile finishes. Seal penetrations with setting material or silicone sealant. Allow joints and penetrations to dry prior to installing tile systems.

3.3 INSTALLATION - GENERAL

- A. Install tile and grout in accordance with applicable requirements of ANSI A108.1 through A108.13, manufacturer's instructions, and TCNA Handbook recommendations.
- B. Request tile pattern if not 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 and base joints.
- D. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make joints watertight, without voids, cracks, excess mortar, or excess grout.
- E. Form internal angles square and external angles square.
- F. Install thresholds where indicated.
- G. Sound tile after setting. Replace hollow sounding units.
- H. Where shown or required, provide expansion joints over concrete expansion joints, construction over concrete cold joints, and perimeter joints in accordance with TCNA Handbook Method EJ171. Apply sealant and back-up to joints.
- I. Keep control joints free of adhesive or grout. Apply sealant to joints.
- J. Allow tile to set for a minimum of 48 hours prior to grouting.
- K. Grout tile joints. Use epoxy grout unless otherwise indicated.
- L. Apply sealant to junction of tile and dissimilar materials and junction of dissimilar planes.
- M. Bull nose pieces shall be used at wall outside corners. Transition strips for flooring shall be included between different finishes. Use uncoupling membrane or flush transitions at all cold joints/expansion joints in concrete slab.

- N. In restrooms and custodial closets provide either concrete curb or structural liners at base and water stop behind tiles.
- O. Provide slip resistant tiles at wet areas, restrooms, drinking fountains, etc.
- P. Coordinate slab with control joints
- Q. Movement joints in tile work per TCNA EJ-171

3.4 INSTALLATION - FLOORS - THIN-SET METHODS

- A. Over interior concrete substrates, install in accordance with TCA Handbook Method F113, latex-portland cement bond coat, with standard grout.
 - 1. Use uncoupling membrane under porcelain tile unless other underlayment is indicated.
 - 2. Where waterproofing membrane is indicated, install in accordance with TCA Handbook Method F122, with latex-portland cement grout.
 - 3. Where epoxy grout is indicated, install in accordance with TCA Handbook Method F115.

3.5 INSTALLATION - FLOORS - MORTAR BED METHODS

- A. Over interior concrete substrates, install in accordance with TCNA Handbook Method F111, with cleavage membrane, unless otherwise indicated.
 - 1. Where waterproofing membrane is indicated, with standard grout or no mention of grout type, install in accordance with TCNA Handbook Method F121.
 - 2. Where epoxy or furan grout is indicated, but not epoxy or furan bond coat, install in accordance with TCNA Handbook Method F114, with cleavage membrane.
 - 3. Provide epoxy grout in all quarry tile locations unless noted otherwise.
 - 4. Provide epoxy grout for the porcelain tile in the servery.
- B. Cleavage Membrane: Lap edges and ends.
- C. Waterproofing Membrane: Install as specified in ANSI A108.13 at wet locations and as indicated on the Drawings.
- D. Mortar Bed Thickness: 1-1/4 inch, unless otherwise indicated.

3.6 INSTALLATION - WALL TILE

- A. On exterior walls install in accordance with TCNA Handbook Method W244, thin-set over cementitious backer units, with waterproofing membrane.
- B. Over cementitious backer units on studs, install in accordance with TCNA Handbook Method W244, using membrane at kitchens and shower rooms.
- C. Over coated glass mat backer board on studs, install in accordance with TCNA Handbook Method W245.
- D. Over interior concrete and masonry install in accordance with TCNA Handbook Method W202, thin-set with dry-set or latex-portland cement bond coat.

3.7 CLEANING

- A. Clean tile and grout surfaces.

3.8 PROTECTION

- A. Do not permit traffic over finished floor surface for 4 days after installation.

END OF SECTION

SECTION 09 51 00 - ACOUSTICAL CEILINGS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Suspended metal grid ceiling system.
- B. Lay-in acoustical ceiling units.

1.2 RELATED REQUIREMENTS

- A. Section 07 90 05 - Joint Sealers: Acoustical sealant.

1.3 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.

1.4 SUBMITTALS

- A. Product Data: Provide data on suspension system components and acoustical units.
- B. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

1.5 QUALITY ASSURANCE

- A. Non rated and Fire-Rated Assemblies: Complete assembly listed and classified by UL for the fire resistance indicated.

1.6 FIELD CONDITIONS

- A. Maintain uniform temperature of minimum 60 degrees F, and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

1.7 COORDINATION

- A. Coordinate Work of this Section with work under Division 23, Mechanical for location of dampers in diffusers and other mechanical items penetrating ceiling, and Division 26, Electrical for location of light fixtures and other electrical items penetrating ceiling.

1.8 WARRANTY

- A. Standard Ceiling Panels: warrant ceiling panels to be free from sagging, warping, shrinking, buckling, or delaminating as a result of manufacturing defects for a period of one (1) year from the date of Substantial Completion.
- B. Sag Resistant Ceiling Panels: warrant products to be free from sagging, warping, shrinking, buckling, or delaminating as a result of manufacturing defects for a period of ten (10) years from the date of Substantial Completion.
- C. Standard Suspension System: Suspension systems shall be warranted to be free from defects in material or factory workmanship and shall not incur 50 percent red rust as defined by ASTM B117 test procedures for a period of ten (10) years from the date of Substantial Completion.
- D. Suspension System / Ceiling Panels: Provide manufacturers standard 15 year warranty for suspension systems when used in combination with same manufacturers sag resistant ceiling panels. Ceiling panels to be free from sagging, warping, shrinking, buckling, or delaminating as a result of manufacturing defects. Suspension systems shall not incur 50 percent red rust as defined by ASTM B117 test during the period of the warranty.

PART 2 - PRODUCTS

2.1 ACOUSTICAL UNITS

- A. Manufacturers:
 - 1. Armstrong World Industries, Inc: www.armstrong.com.
 - 2. CertainTeed Corporation: www.certainteed.com.
 - 3. USG: www.usg.com.
 - 4. Substitutions: Not permitted.
- B. Acoustical Units - General: ASTM E 1264, Class A.
 - 1. Units for Installation in Non Fire-Rated Suspension System:
 - 2. Units for Installation in Fire-Rated Suspension System:
- C. Acoustical Panels Type ACT-1: Painted fiberglass with acoustically transparent membrane, ASTM E 1264 Type IV, Form 2, Pattern E with the following characteristics:
 - 1. Size: 24 x 24 inches.
 - 2. Thickness: 3/4 inches.
 - 3. NRC: 0.70, determined as specified in ASTM E 1264.
 - 4. Edge: Square.
 - 5. Surface Color: White.
 - 6. Surface Pattern: Fine.
 - 7. Product: Ultima #1910 by Armstrong World Industries with 15/16 inch grid; or Architect approved equal by listed manufacturer.
- D. Glass Fiber Acoustical Panels Type ACT- 2: Ceramic and mineral fiber composite, ASTM E 1264 Type XX, Pattern C E, with the following characteristics:
 - 1. Size: 24 x 24 inches.
 - 2. Thickness: 5/8 inches.
 - 3. NRC: 0.55 determined as specified in ASTM E 1264.
 - 4. Edge: Square.

5. Surface Color: White.
6. Surface Pattern: Fine fissured, non-perforated.
7. Product: Ceramaguard Fine Fissured No. 605 by Armstrong World Industries; or Architect approved equal by listed manufacturer

E. Glass Fiber Acoustical Panels Type ACT- 3 (Tipps): Ceramic and mineral fiber composite, ASTM E 1264 Type XX, Pattern C E, with the following characteristics:

1. Size: 24 x 24 inches.
2. Thickness: Match existing thickness.
3. NRC: 0.55 determined as specified in ASTM E 1264.
4. Edge: Square.
5. Surface Color: Match existing color.
6. Surface Pattern: Match existing pattern.
7. Product: Match existing ceiling tile product
8. One-hour Fire-rated to match existing.

2.2 SUSPENSION SYSTEM(S)

A. Manufacturers:

1. Armstrong World Industries, Inc: www.armstrong.com.
2. CertainTeed Corporation: www.certainteed.com.
3. Chicago Metallic Corporation: www.chicagometallic.com.
4. USG: www.usg.com.
5. Substitutions: Not permitted.

B. Suspension Systems - General: ASTM C 635; die cut and interlocking components, with stabilizer bars, clips, splices, perimeter moldings, and hold down clips as required.

C. Exposed Suspension System: Formed galvanized steel, commercial quality cold rolled; intermediate-duty.

1. Profile: Tee; 15/16 inch wide face
2. Construction: Double web.
3. Finish: White painted.
4. Fire-rated for One-hour roof-ceiling assembly at (Tipps)
5. Product: Prelude XL by Armstrong World Industries; or Architect approved equal by listed manufacturers.

2.3 ACCESSORIES

A. Support Channels and Hangers: Galvanized steel; size and type to suit application and ceiling system flatness requirement specified.

B. Powder-Driven Fasteners: 0.300 inch Headed Fasteners with 0.145 inch Shank Diameter pre-assembled ceiling clips.

C. Perimeter Moldings: Same material and finish as grid.

1. At Exposed Grid: Provide W-shaped shadow molding for mounting at same elevation as face of grid.

D. Acoustical Insulation: Specified in Section 07 21 00.

E. Acoustical Sealant For Perimeter Moldings: Specified in Section 07 90 05.

- F. Gasket For Perimeter Moldings: Closed cell rubber sponge tape.
- G. Touch-up Paint: Type and color to match acoustical and grid units.
- H. Ceiling Edge Treatment:
 - 1. Armstrong Axiom Classic Trim; height as indicated on drawings. Include field trim, inside and outside corner posts and corners, drywall trim where indicated, and other accessories for completion of work..

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 INSTALLATION - SUSPENSION SYSTEM

- A. Install suspension system in accordance with ASTM C 636/C 636M 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. Locate system on room axis according to reflected ceiling plan.
- D. Install after major above-ceiling work is complete. Coordinate the location of hangers with other work.
- E. Provide hanger clips during steel deck erection. Provide additional hangers and inserts as required.
- F. 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. 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.
- H. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.
- I. Support fixture loads using supplementary hangers located within 6 inches of each corner, or support components independently.
- J. Do not eccentrically load system or induce rotation of runners.
- K. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
 - 1. Use longest practical lengths.
 - 2. Miter corners.

- L. Form expansion joints where indicated. Maintain visual closure.
- M. Install light fixture boxes constructed of gypsum board above light fixtures in accordance with fire rated assembly requirements and light fixture ventilation requirements.
- N. Install Cloud ceiling tight to layin ceiling above.

3.3 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. Fit border trim neatly against abutting surfaces.
- D. Install units after above-ceiling work is complete.
- E. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.
- F. Cutting Acoustical Units:
 - 1. Make field cut edges of same profile as factory edges.
- G. Where round obstructions occur, provide preformed closures to match perimeter molding.
- H. Lay acoustical insulation for a distance of 48 inches 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 20 ft of an exterior door.

3.4 TOLERANCES

- A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet.
- B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

END OF SECTION

SECTION 09 64 13 - WOOD FLOORING - NAILED

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes site finished wood stage flooring, of the following types:
 - 1. Masonite sheet flooring at black box.
- B. Related Sections:
 - 1. Section 09 90 00 - Painting and Coating.

1.2 REFERENCES

- A. APA-The Engineered Wood Association:
 - 1. APA/EWA PS 1 - Voluntary Product Standard for Construction and Industrial Plywood.
- B. ASTM International:
 - 1. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.

1.3 PERFORMANCE REQUIREMENTS

- A. Vapor Retarder Permeance: Maximum 1 perm when tested in accordance with ASTM E96, Procedure A.

1.4 SUBMITTALS

- A. Product Data: Submit data for each flooring and floor finish material.
- B. Shop Drawings: Indicate installation details, including location and layout of each accessory.
- C. Samples: Submit two samples of each type of wood flooring, 12 inch in size, illustrating full range of color and texture variations expected.
- D. Manufacturer's Installation Instructions: Submit standard and special installation procedures, and perimeter conditions requiring special attention. Include manufacturer's recommendations for accessory products.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Submit maintenance procedures, recommended maintenance materials, suggested schedule for cleaning, stripping, and re-finishing, stain removal methods, and polishes and waxes.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.

- B. Installer: Company specializing in performing work of this section with minimum three years experience and approved by manufacturer.

1.7 PRE-INSTALLATION MEETINGS

- A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.
- C. Review installation procedures including procedures for acclimation of flooring materials.

1.8 ENVIRONMENTAL REQUIREMENTS

- A. Do not install wood flooring until wet construction work is complete and ambient air at installation space has moisture content stabilized between 35 and 50 percent and temperature is stabilized between 65 and 80 degrees F.
 - 1. Do not install wood flooring until wood materials have been acclimated to ambient temperature and humidity conditions for minimum of 72 hours. Stack wood for acclimation procedures to facilitate cross-ventilation of wood materials.
- B. Provide heat, light, and ventilation prior to installation.
- C. Maintain room temperature and humidity for period of two days prior to delivery of materials to installation space, during installation, and continuously after installation.

PART 2 - PRODUCTS

2.1 COMPONENTS

- A. Flooring Nails: Type recommended by flooring manufacturer.
- B. Sleepers and Shims: Softwood lumber, pressure treated for moisture protection, 2 x 4 inch size.
- C. Subflooring: APA plywood, 1/2 and 3/4 inch thicknesses, with square edges.
- D. Masonite: Tempered masonite, 1/4 inch thick, smooth finish, 4 x 8 foot sheets.
- E. Vapor Retarder: ASTM D 4397, polyethylene sheet not less than 6.0 mils thick.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify concrete subfloor surface is smooth and flat to plus or minus 1/4 inch in 10 feet.
- B. Verify required floor mounted utilities are in proper location.
- C. Verify wood flooring has been acclimated to ambient temperatures, and acclimation and ambient temperatures are in accordance with flooring manufacturer's instructions.

3.2 PREPARATION

- A. Sleepers and Shims:
 - 1. Place vapor retarder over concrete slab, lapping edges and ends minimum 6 inches and tape seal.
 - 2. Place sleepers over vapor retarder; space sleepers at 12 inches oc.
 - 3. Shim underside of sleepers to achieve level line of plus or minus 1/4 inch in 10 feet.
 - 4. Anchor sleepers to concrete substrate with powder or pneumatic driven concrete nails; place nails at 16 inches oc.
- B. Subflooring: Place plywood subflooring over sleepers.
 - 1. Lay one layer 3/4 inch thick plywood perpendicular to sleepers, with end joints over sleepers, and screw-fasten at 12 inches oc.
- C. Prepare substrate to receive finish flooring in accordance with manufacturer's instructions.
- D. Broom clean substrate.

3.3 INSTALLATION

- A. Masonite Flooring:
 - 1. Lay one layer 1/2 inch thick plywood perpendicular to subfloor layer, with joints staggered, and fasten at 12 inches oc.
 - 2. Lay masonite perpendicular to top layer of plywood, with joints staggered, and fasten to plywood with countersunk flathead screws.
 - 3. Terminate flooring at centerline of door openings where adjacent floor finish is dissimilar.
 - 4. Install flooring tight to floor access covers.
 - 5. Install flooring under movable partitions without interrupting floor pattern.
 - 6. Provide minimum 3/4 inch expansion space at fixed walls and other interruptions.
 - a. Unless fully concealed by trim, fill expansion space with flush cork expansion strip.
- B. Install base at floor perimeter to cover expansion space.
 - 1. Secure baseboard to wall and nail shoe molding or other trim to baseboard; do not nail to flooring.
- C. Finishing Masonite Flooring:
 - 1. Paint flat black in accordance with Section 09 90 00.

3.4 CLEANING

- A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.
- B. Clean and polish strip floor surfaces in accordance with manufacturer's instructions.

3.5 PROTECTION OF INSTALLED CONSTRUCTION

- A. Section 01 70 00 - Execution and Closeout Requirements: Protecting installed construction.
- B. Prohibit traffic on floor finish for 48 hours after installation.
- C. Protect installed flooring with sheets of hardboard on kraft paper.

END OF SECTION

SECTION 09 65 00 - RESILIENT BASE

PART 1 - GENERAL

1.1 DESCRIPTION:

- A. Preparation of subfloor.
- B. Molded rubber base at walls and millwork.
- C. Miscellaneous edge strips, nosings and trim.

1.2 SUBMITTALS:

- A. Verification Samples: Before any material is delivered to the job site, submit three (3) representative samples of each selected resilient flooring materials, rubber stair treads, stair risers, rubber landings and edging or reducer strip. Tile samples shall be full piece. Sample flooring shall be 12 inch by 12 inch. Base, edging, or reducer strip shall be 12 inch long by full width or height. Stair treads and risers will be full width and height required by 12 inch long.
- B. Submit printed maintenance instructions from the manufacturer for cleaning, buffing and waxing of each resilient flooring materials.

PART 2 - PRODUCTS

2.1 MATERIALS:

- A. All materials shall have a Class I rating with a minimum critical radiant flux of 0.45 watts per square centimeter.
- B. All materials shall be first quality, new material, free from broken corners, edges or other defects. Tile shall be machine cut to a squareness, which will afford tight, gapless joints and true alignment of joints without voids between tiles.
- C. Rubber Base: ASTM F 1861, Type TP rubber, rubber, thermoplastic, 1/8 inch thick by 4 inch high, molded rubber coved base at resilient/concrete flooring; coved base at carpet flooring; prefabricated inside and outside corners;
 - 1. Allstate
 - 2. Burke
 - 3. Roppe
 - 4. Flexco,
- D. High Performance Epoxy two-part Adhesive: Mix as recommended by the manufacturer. Verify compatibility with all products prior to installation. Apply adhesive with trowel as recommended by the manufacturer.
- E. Reducer Strips: Provide rubber reducer strips at exposed carpet edge; color as selected by Architect.

PART 3 - EXECUTION

3.1 PREPARATION:

- A. Conduct moisture test in accordance with ASTM F1869 - maximum allowable amount of moisture emission from floor is 3.0 pounds per 1,000 square feet in 24 hour period, and shall not exceed maximum allowable moisture content as allowed by flooring manufacturer.
- B. Resilient/rubber materials shall be installed by skilled workmen, following the printed installation instructions of the manufacturer. No smoking is to be permitted in areas where resilient materials are being installed.
- C. Maintain a minimum temperature of 72 degF for at least 48 hours before, during and, 48 hours after the application of floor covering.
- D. Install base on prepared surfaces by spreading a thin coat of adhesive on the back of base, and placing it in proper position and in full contact with backing. Joints shall be hairline, fitted tight at opening jambs.

3.2 INSTALLATION:

- A. Do not begin installation until surface is prepared as directed above. To lay floor/stair material is acceptance of the surface.

3.3 TOLERANCES:

- A. Finished floor surface shall be level and smooth within the following tolerances:
 - 1. Vary not more than 1/8 inch in ten feet.
 - 2. Vary not more than 1/32 inch in one foot.

3.4 CLEANING AND PROTECTION:

- A. No traffic shall be permitted until the adhesive has set (48 hours min.). Clean with a neutral cleaner as recommended by manufacturer. Protect all resilient flooring which will be subject to traffic, or which may be damaged due to subsequent construction operations. Use heavy non-staining Kraft paper or other approved means.
- B. On the last day possible before occupancy by the Owner, clean the floors/stairs a second time. Completed job must meet with approval of the Architect. Train the Owner's housekeeping staff about cleaning, waxing and buffing.
- C. Make adjustment to base after air conditioning has been on for 30 days. Re-glue nosings, as necessary for permanent installation.

END OF SECTION

SECTION 09 65 19 - RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. High Performance Luxury Vinyl composition floor tile.

1.2 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of floor tile to include in maintenance manuals.

1.3 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Floor Tile: Furnish one box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for floor tile installation and seaming method indicated.
 - 1. Engage an installer who employs workers for this Project who are trained or certified by floor tile manufacturer for installation techniques required.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F. Store floor tiles on flat surfaces.

1.6 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive floor tile during the following time periods:
 - 1. 48 hours before installation.
 - 2. During installation.
 - 3. 48 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.
- C. Close spaces to traffic during floor tile installation.
- D. Close spaces to traffic for 48 hours after floor tile installation.

- E. Install floor tile after other finishing operations, including painting, have been completed.

1.7 WARRANTY

- A. Provide floor preparation system warranty specified in Section 09 05 61 - Common Work Results for Flooring Preparation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For resilient tile flooring, as determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
 - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

2.2 VINYL COMPOSITION FLOOR TILE (LVT – 1)

- A. Products: Subject to compliance with requirements, provide one of the following as scheduled:
 - 1. Tandus Centiva (High performance Luxury Vinyl Tile)
- B. Tile Standard: ASTM F 1700, Class III, Type B – standard emboss.
- C. Wearing Surface: Smooth, factory applied urethane.
- D. Thickness: 20 Mil.
- E. Size: 15.24 CM x 91.44 CM. (6" wide x 36" long)
- F. Multiple Colors and Patterns: As selected by Architect from manufacturer's full range.
- G. Static Load: 1500 psi

2.3 INSTALLATION MATERIALS

- A. Floor Leveler and Underlayment: (As required): Refer to Section 09 05 61.
- B. Glue Down Adhesives: Type specified in Section 09 05 61 and as approved by flooring manufacturer.
 - 1. Adhesives shall comply with the following limits for VOC content:
 - a. Vinyl Tile Adhesives: 50 g/L or less.
 - 2. Provide specified system warranty.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare substrate according to Section 09 05 61 and floor tile manufacturer's written instructions to achieve specified system warranty.
- 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 wide or wider and protrusions more than 1/32 inch unless more stringent requirements are required by manufacturer's written instructions. Use self-leveling compound for larger areas or areas with more extensive deformations in the concrete.

3.3 FLOOR TILE INSTALLATION

- A. Comply with manufacturer's written instructions for installing floor tile.
- B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
 1. Lay tiles square with room axis.
- C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
 1. Lay vinyl composition tiles in pattern as selected by the Architect
- D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
- E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent marking device.
- G. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in finished floor areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.
- H. Adhere floor tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.4 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting floor tile.
- B. Perform the following operations immediately after completing floor tile installation:
 - 1. Remove adhesive and other blemishes from exposed surfaces.
 - 2. Sweep and vacuum surfaces thoroughly.
 - 3. Damp-mop surfaces to remove marks and soil.
- C. Protect floor tile from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Cover floor tile until Substantial Completion.

END OF SECTION

SECTION 09 65 66 - RESILIENT ATHLETIC FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Composite resilient athletic floor systems for weight room.

B. Related Requirements:

1. Section 09 65 13 "Resilient Base and Accessories" for wall base and accessories installed with resilient athletic flooring.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show installation details and locations of the following:

1. Floor patterns.
2. Seam locations for sheet flooring.

C. Samples: For each exposed product and for each type, color, and pattern specified, 6-inch-square in size and of the same thickness indicated for the Work.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For resilient athletic flooring Installer.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For resilient athletic flooring to include in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

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. Sheet Flooring: Furnish full-width rolls of not less than 10 linear feet for each 500 linear feet or fraction thereof, of each type, color, and pattern of flooring installed.

1.6 QUALITY ASSURANCE

A. Resilient Athletic Flooring Installer Qualifications: Installer with a minimum of 5 years of experience who has completed flooring installations similar in material, design, and extent to that indicated for this Project; who is acceptable to manufacturer; and whose work has resulted in installations with a record of successful in-service performance.

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 storing.
- B. Store materials to prevent deterioration.
 - 1. Store rolls upright.

1.8 FIELD CONDITIONS

- A. Adhesively Applied Products:
 - 1. Maintain temperatures during installation within range recommended in writing by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive flooring 48 hours before installation, during installation, and 48 hours after installation unless longer period is recommended in writing by manufacturer.
 - 2. After postinstallation period, maintain temperatures within range recommended in writing by manufacturer, but not less than 55 deg F or more than 95 deg F.
 - 3. Close spaces to traffic during flooring installation.
 - 4. Close spaces to traffic for 48 hours after flooring installation unless manufacturer recommends longer period in writing.
- B. Install flooring after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 RUBBER SHEET FLOORING

- A. Subject to requirements, provide AktivPro Roll as manufactured by Regupol America LLC; www.regupol.com.
- B. Description: Base layer of elastomeric-encapsulated recycled rubber granules fusion bonded to a high-density EPDM surface layer.
- C. Thickness: 1 inch.
- D. Traffic-Surface Texture: Smooth.
- E. Roll Size: Not less than 48 inches wide by longest length that is practical to minimize splicing during installation.
- F. Color and Pattern: As indicated.

2.2 ACCESSORIES

- A. Trowelable Leveling and Patching Compound: As specified in Section 09 05 61 "Common Work Results for Flooring Preparation."
- B. Adhesives: Water-resistant type recommended in writing by manufacturer for substrate and conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances, moisture content, and other conditions affecting performance of the Work.
 - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare and test concrete substrates in accordance with Section 09 05 61 "Common Work Results for Flooring Preparation" and the following:
 - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 - 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.
 - 3. Verify that substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.
 - 4. Verify that substrate moisture vapor emission and internal relative humidity values are within flooring manufacturer's written recommendations.
 - 5. Fill cracks, holes, and depressions in substrates and remove bumps and ridges to produce a uniform and smooth substrate. 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 wide or wider and protrusions more than 1/32 inch unless more stringent requirements are required by manufacturer's written instructions. Use self-leveling compound for larger areas or areas with more extensive deformations in the concrete.
 - 6. Do not install resilient flooring until it is the same temperature as the space where it is to be installed.
 - a. At least 48 hours in advance of installation, move flooring and installation materials into spaces where they will be installed.
 - 7. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient flooring.

3.3 FLOORING INSTALLATION, GENERAL

- A. Comply with manufacturer's written installation instructions.
- B. Scribe, cut, and fit flooring to butt neatly and tightly to vertical surfaces, equipment anchors, floor outlets, and other interruptions of floor surface.
- C. Extend flooring into toe spaces, door reveals, closets, and similar openings unless otherwise indicated.
- D. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating subfloor markings on flooring. Use nonpermanent, nonstaining marking device.

3.4 SHEET FLOORING INSTALLATION

- A. Unroll sheet flooring and allow it to stabilize before cutting and fitting.
- B. Lay out sheet flooring as follows:
 - 1. Maintain uniformity of flooring direction.
 - 2. Minimize number of seams; place seams in inconspicuous and low-traffic areas, at least 6 inches away from parallel joints in flooring substrates.
 - 3. Match edges of flooring for color shading at seams.
 - 4. Locate seams according to approved Shop Drawings.
- C. Adhere products to substrates using a full spread of adhesive applied to substrate to comply with adhesive and flooring manufacturers' written instructions, including those for trowel notching, adhesive mixing, and adhesive open and working times.
 - 1. Provide completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.5 CLEANING AND PROTECTION

- A. Perform the following operations immediately after completing flooring installation:
 - 1. Remove adhesive and other blemishes from flooring surfaces.
 - 2. Sweep and vacuum flooring thoroughly.
 - 3. Damp-mop flooring to remove marks and soil after time period recommended in writing by manufacturer.
- B. Protect flooring from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods recommended in writing by manufacturer.
 - 1. Do not move heavy and sharp objects directly over flooring. Protect flooring with plywood or hardboard panels to prevent damage from storing or moving objects over flooring.

END OF SECTION

SECTION 09 68 00 - CARPETING

PART 1 - GENERAL

1.1 DESCRIPTION:

- A. The extent of carpeting work is indicated on the Drawings, and by Specifications, and is defined to include installation of carpeting, which will be furnished by the Contractor. Adhesive backed installation as required.
- B. The extent of recarpeting work is indicated on the Drawings, and by Specifications, and is defined to include the removal of existing carpet and installation of new carpeting, which will be furnished by the Contractor.

1.2 SUBMITTALS:

- A. Shop Drawings showing the extent of product, seaming plan, seam direction and location of pile borders, edge moldings and edge bindings shall be submitted to Architect for approval prior to installation. Check pattern match, if any, for matching during installation and possible waste factors in ordering required amounts. Indicate columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required. Copy of approved shop drawings to be available on job site during installation.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics, sizes, patterns, colors available, and method of installation. Provide certification showing the manufacturer's loom on which carpet will be produced.
- C. Verification Samples: Submit two samples 12" x 12" min. size illustrating color and pattern for each carpet material specified.
- D. Flame Spread Certification: Submit manufacturer's certification that carpeting complies with flame spread rating and has been tested to confirm that material meets requirements for Class I.
- E. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.
- F. Maintenance Data: Include manufacturer's approved maintenance procedures, recommendations for maintenance materials and equipment, and suggested schedule for cleaning.

1.3 QUALITY ASSURANCE:

- A. Installer: Firm with not less than 5 years of carpeting experience, similar to work of this section.
- B. Upon request, manufacturer to provide representative to assist in project start-up and to inspect installation while in process and upon completion. Representative will notify designated contact if any installation instructions are not followed.
- C. Single Source Responsibility: Obtain each type of product from one source and by a single manufacturer.

1.4 PRODUCT DELIVERY AND STORAGE:

- A. Accept delivery of carpeting materials and store inside, protected from weather, moisture, and soiling. Deliver materials to the site in manufacturer's original packaging listing manufacturer's name, product name, identification number, and related information.
- 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 on a flat surface, stacked no higher than two rolls.
- C. Store materials for 2 days prior to installation in area of installation to achieve temperature stability.
- D. Maintain minimum 70 degrees ambient temperature 3 days prior to, during, and 24 hours after installation.

1.5 ENVIRONMENTAL REQUIREMENTS:

- A. Manufacturer to off gas carpet at their facilities prior to shipping to jobsite.
- B. Store materials in area of installation for three (3) days prior to installation to achieve temperature stability.
- C. Maintain temperature for installation as per Manufacturers recommendation.
- D. Ventilate installation area during installation and for three (3) days after installation.

1.6 PROJECT CONDITIONS:

- A. Sub-floor preparation is to include all required work to prepare the existing floor for installation of the product as specified in this document and Manufacturer's installation instructions.
- B. All material used in sub-floor preparation and repair shall be recommended by the carpet manufacturer and shall be chemically and physically compatible with the carpet system being bid.
- C. Maintain minimum 65 degrees F ambient temperature and 65% Relative Humidity for 72 hours prior to, during, and 48 hours after installation.
- D. Do not install flooring until space is enclosed and weatherproof, wet-work in space is completed and nominally dry, work above ceilings is complete, and ambient temperature and humidity conditions are and will be continuously maintained at values near those indicated for final occupancy.

1.7 MANUFACTURER'S WARRANTY

- A. Provide 25 years from substantial completion date manufacturer's written warranty for materials and labor.
- B. Contractor to provide written one (1) year warranty for labor and materials from substantial completion date.
- C. Warranty to be sole source responsibility of the Manufacturer. Second source warranties and warranties that involve parties other than the carpet manufacturer are unacceptable.

- D. If the product fails to perform as warranted when properly installed and maintained, the affected area will be repaired or replaced at the discretion of the Manufacturer.
- E. Chair pads are not required, but are recommended for optimum textural performance. Absent the use of chair pads, more intensive maintenance will be required for areas in direct contact with chair caster traffic, and some degree of appearance change is to be expected.
- F. Warranty shall not exclude carpet product installed on stairs provided it is properly installed and maintained.
- G. The non-prorated Lifetime Limited warranty shall specifically warrant against :
 - 1. Excessive Surface Wear: More than 15% loss of pile fiber weight
 - 2. Excessive Static Electricity: More than 3.0 kV per AATCC 134
 - 3. Resiliency Loss of the Backing: More than 10% loss of backing resiliency
 - 4. Delamination
 - 5. Edge Ravel
 - 6. Zippering
- H. Tuft Bind warranty in lieu of edge ravel and zippering is not acceptable.

1.8 EXTRA MATERIAL

- A. Provide two complete rolls of the same run as installed.

PART 2 - PRODUCTS

2.1 CARPET:

- A. Types scheduled on Drawings.

2.2 CARPET ACCESSORIES:

- A. Carpet Edge Guard, Nonmetallic: Provide black extruded or molded rubber carpet edge guard of size and profile indicated or required to coordinate transition to tile/terrazzo floor as indicated; colors as scheduled. Carpet guards at transitions to other flooring are specified as work of Section 09650.
- B. Seaming Cement: Provide hot-melt seaming adhesive or similar product recommended by carpet manufacturer, for taping seams and buttering cut edges at backing to form secure seams and prevent pile loss at seams.

PART 3 - EXECUTION

3.1 PREINSTALLATION REQUIREMENTS:

- A. Contractor must test substrates in accordance with Section 09 05 61 and provide written results for moisture content and other conditions under which carpeting is to be installed. Do not proceed until unsatisfactory conditions have been corrected in compliance with the manufacturer's recommendations.

- B. Clear away debris and scrape up cementitious/other deposits from surfaces to receive carpeting; vacuum clean immediately before installation. Check concrete surfaces to ensure no "dusting" through installed carpet; apply sealer where required to prevent dusting.
- C. Remove sub-floor ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with sub-floor filler.
- D. Apply, trowel and float filler to achieve smooth, flat, hard surface. Prohibit traffic until filler is cured.
- E. Vacuum clean substrate.
- F. Sequence carpeting with other work so as to minimize possibility of damage and soiling of carpet during remainder of construction period. Protect carpet after installation until substantial completion plastic sheet, mats, and Masonite.

3.2 RECARPETING:

- A. Remove all floor set door stops, electrical outlets, box covers and pedestals, trim pieces, top set resilient base, shoe mold, and other items applied over the existing carpet. Remove carpet and pad where shown and as required to even up patches for walls, casework, equipment removals, etc. Remove carpet in strip widths for convenient handling, and remove all ravelings and other carpet and pad leavings from the floor.
- B. Remove all deteriorated adhesives of glue down carpets and sand remainders of crystallized adhesives to match bare spots, or remove unsandable remainders of appropriate solvents, rinse slab clean and dry out. Fill minor or local low spots, cracks, joints, holes, and other defects with sub-floor filler. Apply, trowel, and float filler to achieve smooth, flat, hard surface. Prohibit traffic until filler is cured. Provide replacements for missing and/or damaged fasteners and/or inserts to install floor set items previous installed over existing carpet. At new carpeted areas, modify the existing thresholds and/or door as required to fit new conditions.
- C. Sequence recarpeting with other work so as to minimize possibility of damage and soiling of carpet during remainder of construction period.

3.3 GENERAL INSTALLATION REQUIREMENTS:

- A. Comply with manufacturer's instructions and approved seam diagrams for seam locations and direction of carpet; maintain uniformity of direction and lay of pile. At doors, center seams under doors; do not place seams in traffic direction at doorways. Measure each area and establish layout to comply with carpet plan; balance units within each area to avoid use of less than half-size units except where specifically indicated.
- B. Verify carpet match before cutting to ensure minimal variation between dye lots.
- C. Lay out carpet and locate seams in accordance with CRI 104 Section 7.2 and approved shop drawings.
 - 1. Locate seams in area of least traffic, out of areas of pivoting traffic, and parallel to main traffic.
 - 2. Do not locate seams perpendicular through door openings.
 - 3. Align run of pile in same direction as anticipated traffic and in same direction on adjacent pieces.
 - 4. Locate change of color or pattern between rooms under door centerline.
 - 5. Provide monolithic color, pattern, and texture match within each contiguous area.

- D. Extend carpet under open-bottomed obstructions and under removable flanges and furnishings, and in to alcoves and closets of each space.
- E. Provide cut-outs where required, and bind cut edges properly where not concealed by protective edge guards or overlapping flanges.
- F. Install carpet tight and flat on subfloor, well fastened at edges, with uniform appearance.
- G. Install carpet edge guard where edge of carpet is exposed; anchor guards to substrate.
- H. Store materials for 3 days prior to installation in area of installation to achieve temperature stability.
- I. Repairs and/or replacement of carpets are limited to pieces that are sized 2' x 2' minimum size.
- J. Manufacturer's technical representative to visit project site once carpet installation has begun and shall provide written certification letter indicating that the carpet installation is in accordance with manufacturer's recommendations.
- K. Manufacturer's representative shall provide training session with Owner's maintenance personnel regarding care and cleaning procedures for completed carpet installation.
- L. Fit sections of carpet into each space prior to rolling of adhesive backing. Trim edges and butter cuts with seaming cement.
- M. Butt carpet edges tightly together to form seams without gaps. Roll lightly to eliminate air pockets and ensure uniform bond. Remove adhesive promptly from face of carpet.
- N. Installation on stairs – Direct Glue Down Method: CRI 104 Section 12
 - 1. Use one piece of carpet for each tread and riser below. Apply seam adhesive to cut edges.
 - 2. Install carpet with pile direction in length of stair.
 - 3. Adhere carpet tight to stair treads and risers.

3.4 CLEANING AND PROTECTION:

- A. Remove debris, sorting pieces to be saved from scraps to be disposed of. Retain pieces larger than 4 sq. ft. in areas, which are wider than 8" for Owner's maintenance stock. Roll and wrap 5% overage and place in storage according to Owner's directions.
- B. Vacuum carpet using commercial machine with face-beater element. Remove spots and replace carpet where spots cannot be removed. Use only Tandus approved carpet-cleaning subs.
- C. Remove excess adhesive without damage, from floor, base, and wall surfaces.
- D. Remove all construction debris, etc. from work sites on a daily basis.
- E. Return work area and all adjacent areas used for performing the work back to its original condition prior to carpet installation.
- F. Protect carpeting as necessary so that it will be without deterioration or damage at time of substantial completion. Do not permit traffic over unprotected floor surface.

- G. Cover carpeting in traffic areas with protective non-staining building paper. Do not use plastic sheeting.
- H. Relaying: Return to installation after approximately 6 months of occupancy and use; adjust carpet in each space, repair faults in seaming, trim and adjust carpeting at edges.

END OF SECTION

SECTION 09 77 23 - ACOUSTICAL WALL PANELS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes shop-fabricated, acoustical panel units tested for acoustical performance, including the following:

1. Fabric-wrapped acoustical wall panels.

1.2 DEFINITIONS

- A. NRC: Noise Reduction Coefficient.
B. SAA: Sound Absorption Average.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1. Include fabric facing, panel edge, core material, and mounting indicated.

- B. Shop Drawings: For unit assembly and installation.

1. Include plans, elevations, sections, and mounting devices and details.
2. Include details at panel head, base, joints, and corners. Indicate panel edge profile and core materials.
3. Include details at cutouts and penetrations for other work.
4. Include direction of fabric weave and pattern matching.

- C. Samples - Fabric-Wrapped Wall Panels:

1. Fabric: Full-width by approximately 36-inch- long Sample, but not smaller than required to show complete pattern repeat, from dye lot to be used for the Work, and with specified treatments applied. Mark top and face of fabric.
2. Panel Edge: 12-inch- long Sample(s) showing each edge profile, corner, and finish.
3. Core Material: 12-inch- square Sample at corner.
4. Mounting Devices: Full-size Samples.
5. Assembled Panels: Approximately 18 by 18 inches, including joints and mounting methods.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Elevations and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Electrical outlets, switches, and thermostats.
2. Items penetrating or covered by units including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.

- d. Alarms.
- e. Sprinklers.
- f. Access panels.

3. Show operation of hinged and sliding components covered by or adjacent to units.

- B. Product Certificates: For each type of unit.
- C. Sample Warranty: For manufacturer's special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of unit to include in maintenance manuals. Include fabric manufacturers' written cleaning and stain-removal instructions.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Comply with manufacturer's written instructions for minimum and maximum temperature and humidity requirements for shipment, storage, and handling.
- B. Deliver materials and units in unopened bundles and store in a temperature-controlled dry place with adequate air circulation.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Do not install units until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work at and above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Lighting: Do not install units until a permanent level of lighting is provided on surfaces to receive the units.
- C. Air-Quality Limitations: Protect units from exposure to airborne odors, such as tobacco smoke, and install units under conditions free from odor contamination of ambient air.
- D. Field Measurements: Verify unit locations and actual dimensions of openings and penetrations by field measurements before fabrication, and indicate them on Shop Drawings.

1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace units and components that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to the following:
 - a. Acoustical performance.
 - b. Fabric sagging, distorting, or releasing from panel edge.
 - c. Warping of core.
 - 2. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain wall units specified in this Section from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: Units shall comply with "Surface-Burning Characteristics" or "Fire Growth Contribution" Subparagraph below, or both, as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
 - 1. Surface-Burning Characteristics: Comply with ASTM E 84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Flame-Spread Index: 25 or less.
 - b. Smoke-Developed Index: 450 or less.
 - 2. Fire Growth Contribution: Comply with acceptance criteria of local code and authorities having jurisdiction when tested according to NFPA 265 Method B Protocol or NFPA 286.

2.3 FABRIC-WRAPPED ACOUSTICAL WALL PANELS

- A. General: Manufacturer's standard panel construction consisting of fabric facing laminated to front face, edges, and back of a rigid acoustical core.
 - 1. Manufacturers: Subject to compliance with requirements, provide Carnegie Xorel Artform, or comparable product by the following:
 - a. AVL Systems, Inc.
 - b. Conwed Designscape.
 - c. Decoustics.
 - d. Wenger.
- B. Panel Shape: Flat.
- C. Mounting: Back mounted with manufacturer's standard metal clips or bar hangers, secured to substrate.
- D. Core: Glass-fiber board: ASTM C 612; of type standard with manufacturer; nominal density of 6 to 7 lb/cu. ft., unfaced, and dimensionally stable, molded rigid board; and with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.
- E. Edge Construction: Manufacturer's standard chemically hardened core with no frame.
- F. Edge Profile: Square, with beveled corners.
- G. Facing Material: Fabric as indicated.
- H. Acoustical Performance: Class A sound absorption with NRC of 0.80 to 0.90 according to ASTM C 423.
- I. Panel Thickness: 2 inch.

- J. Panel Shape: As indicated on Drawings.
- K. Mounting Devices: Concealed on back of unit, recommended by manufacturer to support weight of unit, and as follows:
 - 1. Metal Clips or Bar Hangers: Manufacturer's standard two-part metal "Z" clips, with one part of each clip mechanically attached to back of unit and the other part to substrate, designed to permit unit removal.
 - 2. Provide retaining clips on the tops of all panels reachable from floor level to prevent the lifting of panels off of the "Z" clips.

2.4 FABRICATION - FABRIC-WRAPPED WALL PANELS

- A. Standard Construction: Use manufacturer's standard construction unless otherwise indicated; with facing material applied to face, edges, and back border of dimensionally stable core; and with rigid edges to reinforce panel perimeter against warpage and damage.
- B. Edge Hardening: For glass-fiber board cores, chemically harden core edges and areas of core where mounting devices are attached.
- C. Core-Face Layer: Evenly stretched over core face and edges and securely attached to core; free from puckers, ripples, wrinkles, or sags.
- D. Facing Material: Apply fabric facing fully covering visible surfaces of unit; with material stretched straight, on the grain, tight, square, and free from puckers, ripples, wrinkles, sags, blisters, seams, adhesive, or other visible distortions or foreign matter.
 - 1. Square Corners: Tailor corners. Heat-seal vinyl fabric seams at corners.
 - 2. Radius and Other Nonsquare Corners: Attach facing material so there are no seams or gathering of material.
 - 3. Fabrics with Directional or Repeating Patterns or Directional Weave: Mark fabric top and attach fabric in same direction so pattern or weave matches in adjacent units.
- E. Dimensional Tolerances of Finished Units: Plus or minus 1/16 inch for the following:
 - 1. Thickness.
 - 2. Edge straightness.
 - 3. Overall length and width.
 - 4. Squareness from corner to corner.
 - 5. Chords, radii, and diameters.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fabric, fabricated units, substrates, areas, and conditions for compliance with requirements, installation tolerances, and other conditions affecting unit performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install units in locations indicated. Unless otherwise indicated, install units with vertical surfaces and edges plumb, top edges level and in alignment with other units, faces flush, and scribed to fit adjoining work accurately at borders and at penetrations.
- B. Comply with manufacturer's written instructions for installation of units using type of mounting devices indicated. Mount units securely to supporting substrate.
- C. Align fabric pattern and grain with adjacent units.

3.3 INSTALLATION TOLERANCES

- A. Variation from Plumb and Level: Plus or minus 1/16 inch in 48 inches, noncumulative.
- B. Variation of Joint Width: Not more than 1/16-inch variation from hairline in 48 inches, noncumulative.

3.4 CLEANING

- A. Clean panels on completion of installation to remove dust and other foreign materials according to manufacturer's written instructions.
- B. Fabric-Wrapped Wall Panels: Clip loose threads; remove pills and extraneous materials.

END OF SECTION

SECTION 09 81 00 - ACOUSTICAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Acoustical Insulation in sound rated partitions.
 - 2. Acoustical Insulation above suspended ceilings.
- B. Related Requirements:
 - 1. Section 07 21 00 – Thermal Insulation.

1.2 SUBMITTALS

- A. Product Data: Provide data on product characteristics, performance criteria, and product limitations.
- B. Manufacturer's Installation Instructions: Include information on special environmental conditions required for installation and installation techniques.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements, and that products contain no asbestos.

1.3 FIELD CONDITIONS

- A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

PART 2 - PRODUCTS

2.1 ACOUSTICAL INSULATION MATERIALS

- A. Batt Insulation - Walls: ASTM C 665, Type I; preformed batt; friction fit, for interior walls, conforming to the following:
 - 1. Material: Inorganic Glass Fiber with acrylic resin binder or Mineral Wool
 - 2. Flame Spread Index: 25 or less, when tested in accordance with ASTM E 84.
 - 3. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E 84.
 - 4. Acoustical Performance: 3.5 inches
 - a. NRC: 1.05
 - b. STC: 49 minimum, installed in 3-5/8 metal stud wall with 5/8 inch gypsum board on each side.
 - 5. Facing: Unfaced.
 - 6. Manufacturers:
 - a. CertainTeed Corporation; CertaPro AcoustaTherm: www.certainteed.com.
 - b. Johns Manville Corporation; Sound Control Batts: www.jm.com.
 - c. Knauf Insulation; QueitTherm QT: www.knaufinsulation.us.
 - d. Owens Corning Corp; QuietZone Acoustic Batts: www.owenscorning.com

- e. Thermafiber SAFB: www.thermafiber.com
- B. Batt Insulation - Ceilings: ASTM C 665, Type I; preformed batt; above lay-in suspended ceilings, conforming to the following:
 - 1. Material: Inorganic Glass Fiber or Mineral Wool
 - 2. Flame Spread Index: 25 or less, when tested in accordance with ASTM E 84.
 - 3. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E 84.
 - 4. Thickness: 2 and 3.5 inches, as indicated.
 - 5. Size: 24 inches by 48 inches
 - 6. Facing: Unfaced.
 - 7. Manufacturers:
 - a. CertainTeed Corporation; CertaPro AcoustaTherm: www.certainteed.com.
 - b. Johns Manville Corporation; Sound Control Batts: www.jm.com.
 - c. Knauf Insulation; QueitTherm QT: www.knaufinsulation.us.
 - d. Owens Corning Corp; Sonobatts: www.owenscorning.com.
 - e. Thermafiber SAFB: www.thermafiber.com
- C. Sustainability Requirements: Provide glass-fiber blanket insulation as follows:
 - 1. Free of Formaldehyde: Insulation manufactured with 100 percent acrylic binders and no formaldehyde.
 - 2. Low Emitting: Insulation tested according to ASTM D 5116 and shown to emit less than 0.05-ppm formaldehyde.

2.2 ACCESSORIES

- A. Insulation Fasteners: Impaling clip of galvanized steel with washer retainer and clips, to be mechanically fastened to surface to receive insulation, length to suit insulation thickness and substrate, capable of securely and rigidly fastening insulation in place.
- B. Wire Mesh: Galvanized steel, hexagonal wire mesh.
- C. Adhesives - General: Compatible with materials being adhered as instructed by insulation manufacturer for application; maximum VOC content of 50 g/L; GreenSeal GS-36 certified; in lieu of labeled product, independent test report showing compliance is acceptable.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation and adhesive.
- B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

3.2 BATT INSTALLATION

- A. Install insulation in accordance with manufacturer's instructions.
- B. Install in interior wall and furring spaces without gaps or voids. Do not compress insulation.

- C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.
- D. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation. Insulation shall be tight within spaces in partitions, around cut openings, behind and around electrical and mechanical items within or behind partitions and tight to items passing through partitions.
- E. Wall areas above ceiling: At side wall insulation in ceiling cavity, install adhesive-mounted impaling devices with metal caps at 24 inches vertically and at four (4) inches from each side of blankets horizontally. Install blankets with four (4) foot dimension running vertically on spikes, keeping blankets tight to exterior wall without crushing into each other.
- F. Tape seal butt ends, lapped flanges, and tears or cuts in membrane.
- G. Fit insulation tightly above ceiling, loose laid. Refer to the suspended ceiling manufacturer's recommendations to ensure proper installation.

3.3 PROTECTION

- A. Do not permit installed insulation to be damaged prior to its concealment.

END OF SECTION

SECTION 09 90 00 - PAINTING AND COATING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Surface preparation.
- B. Field application of paints, stains, varnishes, and other coatings.
- C. Surfaces to be finished are indicated in this section and on the Drawings.

1.2 REFERENCE STANDARDS

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency.
- B. GreenSeal Standard GS-11 - Architectural Paints and Coatings.
- C. MPI (APL) - Master Painters Institute Approved Products List; Master Painters and Decorators Association.
- D. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Master Painters and Decorators Association.
- E. PDCA P5 - Painters and Decorators Contractors of America, Benchmark Sample Procedures for Paint and Other Decorative Coating Systems, 2004.

1.3 DEFINITIONS

- A. General: Standard coating terms defined in ASTM D 16 apply to this Section.
 - 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. Semigloss refers to medium-sheen finish with a gloss range between 35 and 70 when measured at a 60-degree meter.

1.4 SUBMITTALS

- A. Product Data: For each paint system indicated. Include block fillers and primers.
 - 1. Material List: Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
 - 2. MPI product number (e.g. MPI #47).
 - 3. Cross-reference to specified paint system(s) product is to be used in; include description of each system (copy of relevant MPI Manual page is acceptable).
 - 4. Manufacturer's Information: Manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material.

5. If proposal of substitutions is allowed under submittal procedures, explanation of all substitutions proposed. Where equal product by listed manufacturer other than basis of design, provide line-by-line comparison of substituted product with specified product and cross-reference to MPI specification..
6. Certification by manufacturer that products comply with Contract Documents and are compatible with applicable substrates and with each other.
7. Certification: By manufacturer that all paints and coatings comply with VOC limits specified.
8. Certification: By manufacturer that all paints and coatings do not contain any of the prohibited chemicals specified; GreenSeal GS-11 certification is not required but if provided shall constitute acceptable certification.
9. Samples: Submit three paper "drop" samples, 8-1/2 by 11 inches in size, illustrating range of colors available for each finishing product specified, with texture to simulate actual conditions.
 - a. 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.
 - b. Provide a list of materials and applications for each coat of each Sample. Label each Sample for location and application.
 - c. Where sheen is specified, submit samples in only that sheen.
 - d. Where sheen is not specified, submit each color in each sheen available.
 - e. Allow 30 days for approval process, after receipt of complete samples by Architect.
 - f. Paint color submittals will not be considered until color submittals for major materials not to be painted, such as masonry, factory finished metals, wood cabinets, and wood doors, have been approved.
10. Maintenance Data: Submit data on cleaning, touch-up, and repair of painted and coated surfaces.

1.5 QUALITY ASSURANCE

- A. Applicator Qualifications: Company specializing in performing the work of this section with minimum five years experience whose work has resulted in applications with a record of successful in-service performance.
- B. Maintain one copy of relevant portions of MPI Architectural Painting Specification Manual on project site at all times.
- C. Material Safety Data Sheets: At project site maintain file of MSDS sheets for each product used; become familiar with and follow manufacturer's stated application and safety requirements.
- D. Source Limitations: Obtain block fillers and primers for each coating system from the same manufacturer as the finish coats.
- E. Benchmark Samples (Mockups): Provide a full-coat benchmark finish sample for each type of coating and substrate required. Comply with procedures specified in PDCA P5. Duplicate finish of approved sample Submittals.
 1. See Section 01 40 00 - Quality Requirements, for general requirements for mock-up.
 2. Architect will select one room or surface to represent surfaces and conditions for application of each type of coating and substrate.
 - a. Wall Surfaces: Provide samples on at least 100 sq. ft.
 - b. Small Areas and Items: Architect will designate items or areas required.
 - c. Provide door and frame assembly illustrating coating color, texture, and finish.

- d. Apply benchmark samples, according to requirements for the completed Work, after permanent lighting and other environmental services have been activated. Provide required sheen, color, and texture on each surface.
 - 1) After finishes are accepted, Architect will use the room or surface to evaluate coating systems of a similar nature.
- e. Final approval of colors will be from benchmark samples.
- f. Mock-up may not remain as part of the Work, except as directed by Architect.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label and the following information:
 - 1. Product description (type of paint);
 - 2. MPI designation;
 - 3. Lot number and date of manufacture;
 - 4. Color name and number;
 - 5. Coverage;
 - 6. Surface preparation;
 - 7. Drying time;
 - 8. Cleanup requirements;
 - 9. Instructions for mixing and reducing;
 - 10. Application instructions;
 - 11. VOC content.
 - 12. Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions. Maintain storage containers in a clean condition, free of foreign materials and residue.

1.7 FIELD CONDITIONS

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
- B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
- C. Minimum Application Temperatures for Waterborne Paints: 50 deg F for interiors; unless required otherwise by manufacturer's instructions. Apply waterborne paints only when temperatures of surfaces to be painted and surrounding air are between 50 and 90 deg F.

1.8 EXTRA MATERIALS

- A. See Section 01 60 00 - Product Requirements, for additional provisions.
- B. Supply 1 gallon of each color; store where directed.
- C. Label each container with color and location used in addition to the manufacturer's label.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Provide all paint and coating products used in any individual system from the same manufacturer; no exceptions.
- B. In the event that a single manufacturer cannot provide all specified products, minor exceptions will be permitted provided approval by Architect is obtained using the specified procedures for substitutions.
 - 1. Substitution of other products by the same manufacturer is preferred over substitution of products by a different manufacturer.
 - 2. Substitution of a different system using MPI-approved products by the same manufacturer will be considered.
- C. Basis of Design: The Sherwin-Williams Company; www.sherwin-williams.com.
- D. Subject to compliance with requirements, other acceptable manufacturers are limited to the following:
 - 1. The Sherwin-Williams Company (S-W)
 - 2. ICI Dulux Paints (ICI)
 - 3. PPG Industries, Pittsburgh Paints (PPG)
 - 4. Pratt and Lambert (P&L)
 - 5. Benjamin Moore & Co (BM).
 - 6. Kelly-Moore Paints (K-M)

2.2 MATERIALS - GENERAL

- A. Volatile Organic Compound (VOC) Content:
 - 1. Provide coatings that comply with the most stringent requirements specified in the following:
 - a. CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.

Architectural coatings VOC limits of State in which the project is located.
GreenSeal Standard GS-11

- 2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.
- B. Chemical Content: The following compounds are prohibited:
 - 1. Aromatic Compounds: In excess of 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).
 - 2. Acrolein, acrylonitrile, antimony, benzene, butyl benzyl phthalate, cadmium, di (2-ethylhexyl) phthalate, di-n-butyl phthalate, di-n-octyl phthalate, 1,2-dichlorobenzene, diethyl phthalate., dimethyl phthalate, ethylbenzene, formaldehyde, hexavalent chromium, isophorone, lead, mercury, methyl ethyl ketone, methyl isobutyl ketone, methylene chloride, naphthalene, toluene (methylbenzene), 1,1,1-trichloroethane, vinyl chloride.

- C. **Material Compatibility:** Provide block fillers, primers, and finish-coat materials that are compatible with one another and with the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
- D. **Material Quality:** Provide manufacturer's best-quality 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.
 - 1. **Proprietary Names:** Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions.
- E. **Paints and Coatings:** Provide products listed in Master Painters Institute Approved Product List, current edition available at www.paintinfo.com, for specified MPI Categories, except as otherwise indicated.
 - 1. Provide ready mixed paints and coatings, except field-catalyzed coatings.
 - 2. Where actual products are indicated, specified product takes precedence over MPI designation. Provide the specified product or equal product by other listed manufacturer in lieu of MPI designation. In no way will products of lesser quality, as specified by either MPI designation or actual product, be permitted.
- F. **Accessory Materials:** Linseed oil, shellac, turpentine, paint thinners and other materials not specifically indicated but required to achieve the finishes specified; commercial quality.
 - 1. **Patching Material:** Latex filler.
 - 2. **Fastener Head Cover Material:** Latex filler.

2.3 PAINT SYSTEMS

- A. Provide products as scheduled. Where specific products are not specified use any product by same manufacturer complying with the requirements of the specified MPI designation. MPI systems are listed to designate a level of quality for comparison between manufacturers only. Provide Premium Grade systems (2 top coats) as defined in MPI Architectural Painting Specification Manual, except as otherwise indicated.
- B. Where a specified paint system does not have a Premium Grade, provide Custom Grade system (with 2 top coats).
- C. Where sheen is not specified or more than one sheen is specified, sheen will be selected later by Architect from the manufacturer's full line.
- D. Provide colors as directed by Architect.
 - 1. Allow for minimum of three colors for each system for each room or space, unless otherwise indicated, without additional cost to Owner.
 - 2. Extend colors to surface edges; colors may change at any edge as directed by Architect.

2.4 EXTERIOR PAINT SYSTEMS - GENERAL

- A. **Asphalt Paving Marking:**
 - 1. **EXT 2.1A Latex Zone/Traffic Marking:** MPI #97.

- B. Concrete Vertical and Overhead Surfaces:
 - 1. Applications include but are not limited to walls and soffits.
 - 2. .1A Latex: Latex MPI #11, semi-gloss.
 - a. Walls: Semi-gloss.
 - 3. EXT 3.1K Latex: Alkali Resistant Primer MPI #3, Latex #10, flat.
 - a. Soffits: Flat.
- C. Concrete Paving Marking:
 - 1. EXT 3.2E Latex Zone / Traffic Marking: MPI #97.
- D. Concrete Masonry Units:
 - 1. Water repellent specified in Section 04 20 00.
 - 2. EXT 4.2A Latex: Block Filler MPI #4, Latex MPI #11, semi-gloss.
 - a. Walls: Semi-gloss.
 - 3. EXT 4.2F Epoxy, W.B.: Epoxy Block Filler MPI #116, Epoxy MPI #115.
- E. Structural Steel and Metal Fabrications:
 - 1. Applications include but are not limited to non-galvanized ferrous metals.
 - 2. EXT 5.1M, W.B. Light Industrial Coating: Rust Inhibitive Primer MPI #107, W.B. Light Industrial Coating MPI #164, gloss.
- F. Galvanized Metal:
 - 1. Applications include but are not limited to doors, frames, railings, and piping, bollards, and miscellaneous metal fabrications.
 - 2. Exterior galvanized metal is not to be painted, however any damaged galvanized coating to be recoated.
- G. Wood Paneling Surfaces:
 - 1. Applications include but are not limited to lumber siding.
 - 2. EXT 6.4J Varnish (over stain) (semi-gloss): Wood Stain MPI #13, Varnish MPI #28, 29 or 30.

2.5 INTERIOR PAINT SYSTEMS - GENERAL

- A. Concrete Vertical and Overhead Surfaces:
 - 1. Applications include but are not limited to walls, underside of balconies, underside of mezzanines, and underside of stairs.
 - 2. NT 3.1G, Epoxy, W.B.: Epoxy MPI #115, 215.
 - 3. INT 3.1M Institutional Low Odor/VOC: Interior Primer Sealer MPI #149, Institutional Low Odor/VOC MPI #143, 144, 145, 146, 147 or 148.
- B. Concrete Horizontal Surfaces:
 - 1. INT 3.2L Epoxy Floor Paint, W.B.: Epoxy Floor Paint MPI #93.
- C. Concrete Masonry Units:
 - 1. INT 4.2E Institutional Low Odor/VOC: Latex Block Filler MPI #4, Institutional Low Odor/VOC MPI #143, 144, 145, 146, 147 or 148.
 - 2. INT 4.2J W.B. Epoxy: Latex Block Filler MPI #4, Epoxy MPI #115.

D. Structural Steel and Metal Fabrications:

1. INT 5.1F Polyurethane Pigmented (over epoxy primer): Epoxy Primer MPI #76 or #79, Polyurethane MPI #72.
2. INT 5.1S Institutional Low Odor/VOC: Rust Inhibitive Primer #107, Institutional Low Odor/VOC MPI #143, 144, 145, 146, 147 or 148.

E. Steel Subject to High Temperatures:

1. Applications include but are not limited to stacks and piping.
2. INT 5.2A Heat Resistant Enamel: Heat Resistant Enamel MPI #21, gloss.

F. Galvanized Metal, Not Chromate Passivated:

1. INT 5.3N Institutional Low Odor/VOC: W.B. Galvanized Primer MPI #134, Institutional Low Odor/VOC MPI #143, 144, 145, 146, 147 or 148.

G. Woodwork (Not Floors or Stairs):

1. INT 6.4C Semi-Transparent Stain: Semi-Transparent Stain MPI #90, or 13.
2. INT 6.4T Institutional Low Odor/VOC: Latex Primer MPI #39, Institutional Low Odor/VOC MPI #143, 144, 145, 146, 147 or 148.

H. Plaster and Gypsum Board:

1. Applications include but are not limited to walls, ceilings, soffits, and bulkheads.
2. INT 9.2M Institutional Low Odor/VOC: Latex Primer Sealer MPI #149, Institutional Low Odor/VOC MPI #143, 144, 145, 146, 147 or 148.

2.6 CONCRETE UNIT MASONRY BLOCK FILLERS

A. Concrete Unit Masonry Block Filler: Factory-formulated high-performance latex block fillers.

1. Sherwin-Williams; Heavy Duty Block Filler B42W46: Applied at a dry film thickness of not less than 8.0 mils.

2.7 EXTERIOR PRIMERS

A. Exterior Concrete and Masonry Primer: Factory-formulated alkali-resistant acrylic-latex primer for exterior application.

1. Sherwin-Williams; Loxon Concrete and Masonry Acrylic Primer A24W8300: Applied at a dry film thickness of not less than 3.0 mils. (NO SUBSTITUTIONS)

B. Exterior Ferrous-Metal Primer: Factory-formulated rust-inhibitive metal primer for exterior application.

1. Sherwin-Williams; Pro-Cryl Universal Water Based Primer B66W310: Applied at a dry film thickness of not less than 3.0 mils.

C. Exterior Galvanized Metal Primer: Factory-formulated galvanized metal primer for exterior application.

1. Sherwin-Williams; Pro-Cryl Universal Water Based Primer B66W310: Applied at a dry film thickness of not less than 3.0 mils.

2.8 INTERIOR PRIMERS

- A. Interior Concrete and Masonry Primer: Factory-formulated alkali-resistant acrylic-latex interior primer for interior application.
 - 1. Sherwin-Williams; Loxon Concrete and Masonry Primer B28W8300: Applied at a dry film thickness of not less than 3.0 mils.
 - 2. Interior Gypsum Board Primer: Primer coat as recommended for Pro Industrial Multi-Surface Acrylic paint"
 - 3. Interior Wood Primer for Acrylic-Enamel and Semigloss Alkyd-Enamel Finishes: Factory-formulated alkyd- or acrylic-latex-based interior wood primer.
 - a. Sherwin-Williams; Premium Interior Wall & Wood Primer B28W811 Series: Applied at a dry film thickness of not less than 1.6 mils.
 - 4. Interior Ferrous-Metal Primer: Factory-formulated quick-drying rust-inhibitive alkyd-based metal primer.
 - a. Sherwin-Williams; Pro-Cryl Universal Water Based Primer B66W310: Applied at a dry film thickness of not less than 3.0 mils.
 - 5. Interior Zinc-Coated Metal Primer: Factory-formulated galvanized metal primer.
 - a. Sherwin-Williams; Pro-Cryl Universal Water Based Primer B66W310: Applied at a dry film thickness of not less than 3.0 mils.
 - 6. Epoxy Primer:
 - a. Sherwin-Williams; Pro Green 200 Interior Latex Primer Series: Applied at a dry film thickness of not less than 1.6 mils.

2.9 EXTERIOR FINISH COATS

- A. Exterior Concrete and Masonry Intermediate finish coat:
 - 1. Sherwin-Williams; 2 cts Pro Industrial Multi-Surface Acrylic paint
- B. Exterior Low-Luster Acrylic Paint: Factory-formulated low-sheen (satin) acrylic-latex paint for exterior application.
 - 1. Sherwin-Williams; 2 cts Pro Industrial Multi-Surface Acrylic paint
- C. Exterior Semigloss Acrylic Enamel: Factory-formulated semigloss waterborne acrylic-latex enamel for exterior application.
 - 1. Sherwin-Williams; 2 cts Pro Industrial Multi-Surface Acrylic paint

2.10 INTERIOR FINISH COATS

- A. Interior Low-Luster Acrylic Enamel: Factory-formulated eggshell acrylic-latex interior enamel.
 - 1. Sherwin-Williams; 2 cts Pro Industrial Multi-Surface Acrylic paint
 - 2. Sherwin-Williams; 2 cts Pro Industrial Multi-Surface Acrylic paint
 - 3. Epoxy Coatings: Two-component water-based epoxy.
 - a. Sherwin-Williams; Pro Industrial Hi-Bild Waterbased Catalyzed Epoxy, Part A B71-100 Series and Part B B71V110 Low Luster Hardener.

PART 3 - EXECUTION

3.1 SCOPE -- SURFACES TO BE FINISHED

- A. Paint all exposed surfaces except where indicated not to be painted or to remain natural; the term "exposed" includes areas visible through permanent and built-in fixtures when they are in place.
- B. Paint the surfaces described in PART 2, indicated on the Drawings, and as follows:
 - 1. If a surface, material, or item is not specifically mentioned, paint in the same manner as similar surfaces, materials, or items, regardless of whether colors are indicated or not.
 - 2. Paint surfaces behind movable equipment and furnishings the same as similar exposed surfaces.
 - 3. Paint surfaces to be concealed behind permanently installed fixtures, equipment, and furnishings, using primer only, prior to installation of the permanent item.
 - 4. Finish top, bottom, and side edges of exterior doors the same as exposed faces.
 - 5. Paint all insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, mechanical equipment, and electrical equipment occurring in finished areas to match background surfaces, unless otherwise indicated.
 - 6. Paint equipment, piping, conduit, and exposed duct work in utility areas in colors according to the color coding scheme indicated.
 - 7. Paint all mechanical and electrical equipment, excluding factory-finished equipment, exposed to weather or to view on the roof and outdoors.
 - 8. Paint shop-primed mechanical and electrical items occurring in finished areas.
 - 9. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
 - 10. Paint interior surfaces of air ducts and convector and baseboard heating cabinets with flat, nonspecular black paint where visible through registers, grilles, or louvers.
 - 11. Paint dampers exposed behind louvers, grilles, and convector and baseboard cabinets to match face panels.
 - 12. Paint both sides and edges of plywood backboards for electrical and telephone equipment before installing equipment.
 - 13. Do Not Paint or Finish the Following Items:
 - a. Items fully factory-finished unless specifically noted; factory-primed items are not considered factory-finished.
 - b. Items indicated to receive other finish.
 - c. Items indicated to remain naturally finished.
 - d. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.
 - e. Anodized aluminum.
 - f. Polished and brushed stainless steel items.
 - g. Brick, precast concrete, integrally colored plaster.
 - h. Concrete masonry in utility, mechanical, and electrical spaces.
 - i. Polished and brushed stainless steel, anodized aluminum, bronze, terne, and lead.
 - j. Acoustical materials.
 - k. Concealed piping, ductwork, and conduit.
 - 14. ADDITIONS/RENOVATIONS - Extend existing paint and coatings installations using materials and methods compatible with existing installations and as specified.

3.2 EXAMINATION

- A. Verify that surfaces are ready to receive Work as instructed by the product manufacturer.

- B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.
- C. Test shop-applied primer for compatibility with subsequent cover materials; report incompatible primer conditions and submit recommended changes for Architect's approval.
- D. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
 - 1. Plaster and Gypsum Board: 12 percent.
 - 2. Masonry, Concrete, and Concrete Unit Masonry: 12 percent.
 - 3. Interior Wood: 15 percent, measured in accordance with ASTM D 4442.
 - 4. Exterior Wood: 15 percent, measured in accordance with ASTM D 4442.
 - 5. Concrete Floors: 8 percent.
 - 6. Measure the pH factor of concrete, masonry, and mortar before starting any finishing process, using the method specified in MPI Architectural Painting Manual.
 - a. Report results in writing to Architect before starting work.
 - b. If results of test indicates need for remedial action, provide written description of remedial action. If a different primer or paint systems is required, state the total cost of the change. Do not proceed with remedial action or change without receiving written authorization from Architect.

3.3 PREPARATION

- A. Prepare surfaces as specified in MPI Architectural Painting Specification Manual and as follows for the applicable surface and coating; if multiple preparation treatments are specified, use as many as necessary for best results; where the Manual references external standards for preparation (e.g. SSPC standards), prepare as specified in those standards; comply with coating manufacturer's specific preparation methods or treatments, if any.
- B. Coordinate painting work with cleaning and preparation work so that dust and other contaminants do not fall on newly painted, wet surfaces.
- C. Surface Appurtenances: Prior to preparing surfaces or finishing, remove electrical plates, hardware, light fixtures, light fixture trim, escutcheons, machined surfaces, fittings, and similar items already installed that are not to be painted.
 - 1. If removal is impractical or impossible because of the size or weight of the item, provide surface-applied protection before preparation and finishing.
 - 2. After completing painting in each space or area, reinstall items removed using workers skilled in the trades involved.
 - 3. Surfaces: Correct defects and clean surfaces which affect work of this section. Remove or repair existing coatings that exhibit surface defects.
 - 4. Marks: Seal with shellac those which may bleed through surface finishes.
 - 5. Impervious Surfaces: Remove mildew by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
 - 6. Concrete, Cement Plaster and Unit Masonry Surfaces to be Painted: Remove dirt, loose mortar, scale, salt or alkali powder, and other foreign matter. Remove oil and grease with a solution of tri-sodium phosphate; rinse well and allow to dry. Remove stains caused by weathering of corroding metals with a solution of sodium metasilicate after thoroughly wetting with water. Allow to dry.

- a. Prepare concrete, concrete masonry block, cement plaster, and mineral-fiber-reinforced cement panel surfaces to be painted. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.
 - b. Determine alkalinity and moisture content of surfaces by performing appropriate tests as specified in MPI Manual. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application. Do not paint surfaces where moisture is present.
7. Gypsum Board Surfaces to be Painted: Fill minor defects with filler compound. Spot prime defects after repair.
 8. Plaster Surfaces to be Painted: Fill hairline cracks, small holes, and imperfections with latex patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high alkali surfaces.
 9. Concrete Floors to be Painted: Remove contamination, acid etch, and rinse floors with clear water. Verify required acid-alkali balance is achieved. Allow to dry.
 10. Aluminum Surfaces to be Painted: Remove surface contamination by steam or high pressure water. Remove oxidation with acid etch and solvent washing. Apply etching primer immediately following cleaning.
 11. Galvanized Surfaces to be Painted: Remove surface contamination and oils and wash with solvent. Apply coat of etching primer.
 12. Uncoated Steel and Iron Surfaces to be Painted: Remove grease, mill scale, weld splatter, dirt, and rust. Where heavy coatings of scale are evident, remove by hand wire brushing or sandblasting; clean by washing with solvent. Apply a treatment of phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Prime paint entire surface; spot prime after repairs.
 - a. Use solvent or mechanical cleaning methods that comply with the Steel Structures Painting Council's (SSPC) recommendations. 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 the same primer as the shop coat.
 13. Shop-Primed Steel Surfaces to be Finish Painted: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.
 14. Interior Wood Items to Receive Opaque Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats. Back prime concealed surfaces before installation.
 15. Interior Wood Items to Receive Transparent Finish: Sand wood to obtain a uniform appearance before immediately starting work. Wipe off dust and grit prior to sealing, seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after sealer has dried; sand lightly between coats. Prime concealed surfaces with gloss varnish reduced 25 percent with thinner.
 16. Metal Doors to be Painted: Prime metal door top and bottom edge surfaces.
 17. Asphalt, Creosote, or Bituminous Surfaces Scheduled for Paint Finish: Remove foreign particles to permit adhesion of finishing materials. Apply compatible sealer or primer.
 18. Insulated Coverings: Remove dirt, grease, and oil from canvas and cotton.
 19. Copper Surfaces Scheduled for Paint Finish: Remove contamination by steam, high pressure water, or solvent washing. Apply vinyl etch primer immediately following cleaning.
 20. Copper Surfaces Scheduled for Natural Oxidized Finish: Remove contamination by applying oxidizing solution of copper acetate and ammonium chloride in acetic acid. Rub on repeatedly for required effect. Once attained, rinse surfaces with clear water and allow to dry.

21. Plaster Surfaces: Fill hairline cracks, small holes, and imperfections with latex patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high alkali surfaces.

3.4 APPLICATION

- A. Apply products in accordance with manufacturer's instructions and as specified or recommended by MPI Manual, using the preparation, products, sheens, textures, and colors as indicated.
 1. Provide completed work matching approved samples for color, texture, and coverage.
 2. Remove, refinish, or repaint work not complying with requirements.
 3. Do not apply finishes over dirt, rust, scale, grease, moisture, scuffed surfaces, or other conditions detrimental to formation of a durable coating film; do not apply finishes to surfaces that are not dry.
 4. Use applicators and methods best suited for substrate and type of material being applied and according to manufacturer's instructions.
 - a. Brush Application: Use brushes best suited for the type of material applied; use brush of appropriate size for the surface or item being painted; produce results free of visible brush marks.
 - b. Roller Application: Use rollers of carpet, velvet back, or high-pile sheep's wool as recommended by manufacturer for material and texture required.
 - c. Spray Application: Use airless spray equipment with orifice size as recommended by manufacturer for material and texture required.
 - d. Where application method is listed in the MPI Manual for the paint system that application method is required; otherwise any application method recommended by manufacturer for material used and objects to be painted is acceptable.
 5. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate; provide total dry film thickness of entire system as instructed by manufacturer or specified herein, whichever is the more stringent.
 - a. Number of coats and film thickness required are the same regardless of application method.
 - b. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance.
 - c. Give special attention to ensure edges, corners, crevices, welds, and exposed fasteners receive dry film thickness equivalent to that of flat surfaces.
 6. Apply finish to completely cover surfaces with uniform appearance without brush marks, runs, sags, laps, ropiness, holidays, spotting, cloudiness, or other surface imperfections.
 - a. Apply each coat of paint slightly darker than preceding coat.
 - b. Before applying finish coats, apply a prime coat of material recommended by manufacturer, unless the surface has been prime coated by others; where evidence of suction spots or unsealed areas in first coat appear, recoat primed and sealed surfaces to ensure finish coat with no burn through or other defects due to insufficient sealing.
 - c. Apply first coat to surface that has been cleaned, pretreated, or otherwise prepared as soon as practical after preparation and before subsequent surface deterioration.
 - d. Do not apply succeeding coats until the previous coat has cured as recommended by manufacturer.
 - e. Do not recoat until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and application of another coat will not cause the undercoat to lift or lose adhesion.
 - f. If manufacturer's instructions recommend sanding to produce a smooth, even surface, sand between coats.

- g. Before applying next coat vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
 - h. Pigmented (Opaque) Finishes: Provide smooth, opaque surface of uniform finish, color, appearance, and coverage.
 - i. Stippled Finish: Roll and redistribute paint to even, fine texture; leave no evidence of rolling, such as laps, irregularity in texture, skid marks, or other surface imperfections; back roll final coat to achieve a uniform surface.
7. Where adjacent sealant is to be painted, do not apply finish coats until sealant is applied.

3.5 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for general requirements for field inspection.
- B. Owner reserves the right to invoke the following test procedure at any time and as often as Owner deems necessary during the period when paint is being applied:
 - 1. Owner may engage a qualified independent testing agency to sample paint material being used. Samples of material delivered to Project will be taken, identified, sealed, and certified in the presence of Contractor.
 - 2. Owner may direct Contractor to stop painting if test results show material being used does not comply with specified requirements. Construction Manager shall remove noncomplying paint from Project site, pay for testing, and repaint surfaces previously coated with the noncomplying paint. If necessary, Contractor may be required to remove noncomplying paint from previously painted surfaces if, on repainting with specified paint, the two coatings are incompatible.

3.6 CLEANING AND PROTECTION

- A. Collect waste material which may constitute a fire hazard, place in closed metal containers, and remove daily from site.
- B. At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from site.
- C. Protect other work, whether being painted or not, against damage by painting. Correct damage by cleaning, repairing or replacing, and repainting as approved by Architect.
- D. Provide "Wet Paint" signs to protect newly painted finishes. Remove temporary protective wrappings provided by others to protect their work after completing painting operations.
- E. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in MPI Manual.

3.7 EXTERIOR PAINT SCHEDULE

- A. Concrete, Stucco, and Masonry (Other Than Concrete Unit Masonry): Provide the following finish systems over exterior concrete, stucco, and brick masonry substrates:
 - 1. Low-Luster Acrylic Finish: Two finish coats over a primer.
 - a. Primer: Exterior concrete and masonry primer.
 - b. Finish Coats: Exterior low-luster acrylic paint.
- B. Concrete Unit Masonry: Provide the following finish systems over exterior concrete unit masonry:

1. Low-Luster Acrylic Finish: Two finish coats over a block filler.
 - a. Block Filler: Concrete unit masonry block filler.
 - b. Finish Coats: Exterior low-luster acrylic paint.

- C. Ferrous Metal: Provide the following finish systems over exterior ferrous metal. Primer is not required on shop-primed items.
 1. Semigloss Acrylic-Enamel Finish: Two finish coats over a rust-inhibitive primer.
 - a. Primer: Exterior ferrous-metal primer.
 - b. Finish Coats: Exterior semigloss acrylic enamel.

- D. Zinc-Coated Metal: Provide the following finish systems over exterior zinc-coated metal surfaces:
 1. Semigloss Acrylic-Enamel Finish: Two finish coats over a galvanized metal primer.
 - a. Primer: Exterior galvanized metal primer.
 - b. Finish Coats: Exterior semigloss acrylic enamel.

3.8 INTERIOR PAINT SCHEDULE

- A. Concrete and Masonry (Other Than Concrete Unit Masonry): Provide the following paint systems over interior concrete and brick masonry substrates:
 1. Low-Luster Acrylic-Enamel Finish: Two finish coats over a primer.
 - a. Primer: Interior concrete and masonry primer.
 - b. Finish Coats: Interior low-luster acrylic enamel.
 - c. Semigloss Acrylic-Enamel Finish: Two finish coats over a primer.
 - 1) Primer: Interior concrete and masonry primer.
 - 2) Finish Coats: Interior semigloss acrylic enamel.
 2. Concrete Unit Masonry: Provide the following finish systems over interior concrete masonry:
 - a. Low-Luster Acrylic-Enamel Finish: Two finish coats over a block filler.
 - 1) Block Filler: Concrete unit masonry block filler.
 - 2) Finish Coats: Interior low-luster acrylic enamel.
 - b. Semigloss Acrylic-Enamel Finish: Two finish coats over a block filler.
 - 1) Block Filler: Concrete unit masonry block filler.
 - 2) Finish Coats: Interior semigloss acrylic enamel.
 3. Gypsum Board: Provide the following finish systems over interior gypsum board surfaces:
 - a. Low-Luster Acrylic-Enamel Finish: Two finish coats over a primer.
 - 1) Primer: Interior gypsum board primer.
 - 2) Finish Coats: Interior low-luster acrylic enamel.
 - b. Water-Based Epoxy Coating System:
 - 1) Prime Coat: Interior latex primer/sealer.
 - 2) Intermediate Coat: Water-based epoxy.
 - 3) Top Coat: Water-based epoxy.
 4. Ferrous Metal: Provide the following finish systems over ferrous metal:
 - a. Semigloss Acrylic-Enamel Finish: Two finish coats over a primer.
 - 1) Primer: Interior ferrous-metal primer.
 - 2) Finish Coats: Interior semigloss acrylic enamel.
 5. Zinc-Coated Metal: Provide the following finish systems over interior zinc-coated metal surfaces:
 - a. Semigloss Acrylic-Enamel Finish: Two finish coats over a primer.

- 1) Primer: Interior zinc-coated metal primer.
 - 2) Finish Coats: Interior semigloss acrylic enamel.
6. All-Service Jacket over Insulation: Provide the following finish system on cotton or canvas insulation covering:
- a. Flat Acrylic Finish: Two finish coats. Add fungicidal agent to render fabric mildewproof.
 - 1) Finish Coats: Interior flat latex-emulsion size.

END OF SECTION

SECTION 10 11 01 - VISUAL DISPLAY BOARDS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Markerboards.

1.2 RELATED REQUIREMENTS

- A. Section 09 22 16 - Non-Structural Metal Framing: Concealed supports in metal stud walls.

1.3 REFERENCE STANDARDS

- A. ANSI A208.1 - American National Standard for Particleboard.
- B. ASTM A424 - Standard Specification for Steel, Sheet, for Porcelain Enameling.

1.4 SUBMITTALS

- A. Product Data: Provide manufacturer's data on markerboard, trim, and accessories.
- B. Shop Drawings: Indicate wall elevations, dimensions, joint locations , special anchor details.
- C. Manufacturer's printed installation instructions.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years experience.

1.6 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Provide 50 year warranty for porcelain markerboard to include warranty against discoloration due to cleaning, crazing or cracking, staining, and delamination of porcelain.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Visual Display Boards:
 1. MooreCo, Inc: www.moorecoinc.com.
 2. Ghent Manufacturing, Inc.: www.ghent.com.
 3. Aarco Products, Inc.
 4. ABC School Equipment (Platinum Visual Systems)
 5. ADP Lemco Incorporated, (ALinc)

6. Best-Rite Manufacturing
7. Carolina Chalkboards Co.
8. Claridge
9. Newline Products, Inc.
10. PolyVision

2.2 VISUAL DISPLAY BOARDS

- A. Markerboards: Porcelain enamel on steel, laminated to core (Large).
1. Color: White.
 2. Metal Face Sheet Thickness: 0.015 inch (24 gage).
 3. Core: Particleboard, manufacturer's standard thickness, laminated to face sheet.
 4. Backing: Mylar or Aluminum foil, laminated to core.
 5. Height: 48 inches.
 6. Length: As indicated on drawings.
 7. Frame: Extruded aluminum , with concealed fasteners.
 8. Frame Finish: Anodized, natural.
 9. Accessories: Provide chalk tray and aluminum trim.
 10. Use the following or equivalent made by one of the listed manufacturers: Best-Rite Porcelain Steel Markerboard, or approved equal.

2.3 MATERIALS

- A. Porcelain Enameled Steel Sheet: ASTM A424, Type I, Commercial Steel, with fired-on vitreous finish.
- B. Particleboard: ANSI A208.1; wood chips, set with waterproof resin binder, sanded faces.
- C. Foil Backing: Aluminum foil sheet, 0.005 inch thick.

2.4 ACCESSORIES

- A. Adhesives: Type used by manufacturer.
- B. Map Rail: Similar to No. 76M, heavy duty steel or aluminum, manufacturer's standard profile, with cork insert and runners for accessories; 1 inch wide overall , full width of frame. Provide 4 map hooks.
- C. Temporary Protective Cover: Sheet polyethylene, 8 mil thick.
- D. Flag Holders (2): Cast aluminum bored to receive 1 inch diameter flag staff, bracketed to fit top rail of board.
- E. Mounting Brackets: Angle clips.

2.5 TACKBOARD (TB):

- A. Vinyl plastic mounted on 1/4 inch resilient cork over 1/4 inch hardboard underlayment (1/2 inch total thickness).
- B. Type: Similar to "Fabricork".
- C. Color: As selected by Architect from manufacturer's standards.

- D. Sizes/Locations: As shown on drawings or required.
- E. Trim:
 - 1. Extruded aluminum snap on trim with surface applied metal grounds.
 - 2. Type: Similar to Series 270.
 - 3. Color: Dull satin anodized, natural.

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.

3.2 INSTALLATION

- A. Install boards in accordance with manufacturer's instructions, at height indicated on drawings.
- B. Install with bottom of perimeter frame at 30 inches above finished floor.
- C. Secure units level and plumb.
- D. Rigidly anchor to backup materials at 16 inch on center maximum. Set without mastic on gypsum board partitions. Do not glue boards to backup material.

3.3 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.

END OF SECTION

SECTION 10 14 00 - SIGNAGE

PART ? - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Building Directories.
 - 2. Room Identification signage and Interior Way-Finding directional signage
 - 3. Brackets, clips, pipe and tube posts, fasteners, concrete footings, anchors, and all accessories required for proper installation of signage.
 - 4. Fire Department Connections signage
 - 5. Fire Sprinkler Riser room
 - 6. Roof warranty
- B. Work Included: Perform all work necessary to complete and install all sign and graphic products including supports and mounting hardware, as shown on the drawings or inferable therefrom, and/or as specified herein. The Work includes obtaining all necessary permits from applicable agencies.
- C. Related Sections include the following:
 - 1. Division 1 Section "Temporary Facilities and Controls" for temporary Project identification signs and for temporary information and directional signs.
 - 2. Division 5 Section "Ornamental Metal" for custom enclosures for directories and directionals.
 - 3. Division 15 Section "Mechanical Identification" for labels, tags, and nameplates for mechanical equipment.
 - 4. Division 16 Sections for electrical service and connections for illuminated signs.
 - 5. Division 16 Section "Electrical Identification" for labels, tags, and nameplates for electrical equipment.
 - 6. Division 16 Section "Interior Lighting" for illuminated Exit signs.

1.2 REFERENCES

- A. "American National Standard Institute: Accessible and Usable Buildings and Facilities" ICC/ANSI A117.1A-1998, current revision, published by the International Code Council.
- B. "Instruction Manual for Braille Transcribing" Fourth Edition, 2000, National Service for the Blind and Physically Handicapped.
- C. "English Braille, American Edition, 1994" American Printing House for the Blind.

1.3 DEFINITIONS

- A. ADA-ABA Accessibility Guidelines: U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines."

1.4 PERFORMANCE REQUIREMENTS

- A. Structural Performance: All signs shall withstand the effects of gravity loads and loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
- B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 67 deg C, ambient; 100 deg C, material surfaces.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Typeface Samples: Submit laser prints of typeface samples with a full character set to match those of the "Typography" section of the Drawings at 72 point size. Produce samples on the same device as that used to produce camera artwork and/or router outlines.
- C. Shop Drawings: Show fabrication and installation details for signs.
 - 1. Show sign mounting heights, locations of supplementary supports to be provided by others, adjacent signs that will affect position or layout of subject signs, architectural features such as joints in wall finish materials, and accessories.
 - 2. Depict materials, material grades and thicknesses, finishes, substructure, footings, fabrication joints, corners, edges, intersections, fasteners, and copy composition including letter and line spacing.
 - 3. Prepare details at not less than 1:4 minimum scale with critical points at full scale.
 - 4. Provide message list, typestyles, graphic elements, including tactile characters and Braille, and layout for each sign.
- D. Samples for Initial Selection: Manufacturer's color charts consisting of actual units or sections of units showing the full range of colors available for the following:
 - 1. Opaque, translucent, and reflective vinyl.
- E. Samples for Verification: For each of the following products and for the full range of color, texture, and sign material indicated, of sizes indicated:
 - 1. Dimensional Characters: Full-size Samples of each size, color, material, and typeface of dimensional character (letter, number, and graphic element).
 - 2. Aluminum: For each form, finish, and color, on 150-mm-long sections of extrusions and squares of sheet at least 250 mm by 250 mm, and of the same gauge as finished product.
 - 3. Acrylic Sheet: 250 mm by 250 mm for each color required.
 - 4. Coatings: 250 mm by 250 mm for each color required. Color samples shall be on similar substrate to finished product and shall be treated with any specified films or coatings.
 - 5. Glass: 250 mm by 250 mm for each type and thickness required. Samples shall include any edge treatment, laminations, and films required.
- F. Prototypes: One completed full-scale prototype of each of the following signs, fully assembled and identical to the production run:
 - 1. Sign type: Office XXX.
 - 2. Sign type: Classroom XXX.

- G. Copy Layouts: Half-size laser or plotter prints on bond paper of all sign faces with actual fabrication-ready formatting. Annotate layouts to indicate location, as per Message Schedule and Sign Location Plan conventions. Output shall be of sufficient resolution that visual integrity of the layout may be inspected. Produce samples on the same device as that used to produce camera artwork and/or router outlines.
- H. Sign Message Schedule: Use same designations indicated on Drawings.
- I. Qualification Data: For Installer.
- J. Maintenance Data: For signs to include in maintenance manuals.
- K. Warranty: Special warranty specified in this Section.
- L. Close-out Submittals:
 - 1. Updated As-Built drawings and shop drawings
 - 2. Product material colors, accessory model numbers and contact names/addresses for future re-ordering parts by Owner

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Installer must be the Fabricator of products or an employer of workers trained and approved by fabricator.
- B. Fabricator Qualifications: The Fabricator must be a 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.
- C. Source Limitations for materials: Obtain each material required from one source from a single manufacturer.
- D. Regulatory Requirements: Comply with applicable provisions in ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.
- E. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 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: 50 or less.
- F. Preinstallation Conference: Conduct conference at Project site.

1.7 STANDARDS

- A. Verify sign and copy length for proper fit. Notify Architect in writing prior to fabrication of any messages or translations which do not fit on the specified sign. Do not modify typography to fit signs.
- B. Notify Architect in writing of any discrepancies in the documents prior to fabrication.
- C. All materials shall be new stock, free from defects impairing strength, durability, or appearance.

- D. All fabrication and installation shall be accordance with the highest standards of the trade. All signs and components shall be complete and free from visual defects such as unfilled and unfinished seams or exposed fasteners.
- E. Restore damaged sign finishes to original condition.
- F. All copy noted as Braille shall be Grade 2 Braille to match the performance and use specifications of Title III of the Americans with Disabilities Act, Public Law 101-336. The signage fabricator shall verify accuracy of all Braille messages.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install signs until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
- B. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit installation of signs in exterior locations to be performed according to manufacturers' written instructions and warranty requirements.
- C. Field Measurements: Verify dimensions of openings, recesses, wall lengths, clear heights, clear widths, and other relevant dimensions by field measurements before fabrication and indicate measurements on Shop Drawings.

1.9 COORDINATION

- A. Coordinate placement of anchorage devices with templates for installing signs.

1.10 WARRANTY

- A. Special Warranty: Fabricator's standard form in which fabricator agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Deterioration of materials or finishes beyond normal weathering.
 - b. Separation of components due to failure of adhesive or fasteners.
 - 2. Warranty Period: Five years from date of Substantial Completion.

PART ? - PRODUCTS

1.11 FABRICATION: GENERAL

- A. Execute all fabrication such that all edges and corners of finished letter forms and sign substrates are true and clean.
- B. Execute all finishes such that all surfaces shall have a smooth even finish free of any irregularities, such as pinholes, orange-peeling, scratches, application marks, or other imperfections.
- C. Align letter forms so as to maintain a baseline parallel to the sign format. Maintain margins as specified by sign type layouts.

- D. Cut sheet metal letterforms from rolled sheet of specified gauge. All edges of copy shall be perpendicular to copy face, ground smooth and polished to finish as noted on drawings and schedules. Eliminate surface deflection, "oil-canning", and warping.
- E. Photo-chemically etch all signs and copy noted on drawings as acid-etched or photopolymer to a depth of 0.8 mm, unless otherwise shown on drawings. Etched surfaces shall be paint-filled in the color noted on drawings. Execute all etching so that all edges and corners of finished copy or graphics are true and clean. Contours of Braille etching shall comply with Braille standards.
- F. All engraving shall be on computerized CNC engraving systems.
- G. Execute all silk screens from photo-screens or negatives prepared per Specifications and Drawings. Silkscreen mesh shall be 390 or finer. Do not use images from the Contract Documents as camera-ready art.
- H. Execute silkscreen printing such that all edges and corners of finished letterforms are true and clean.
- I. Use paints of a type made for the surface material on which they will be applied, per manufacturers' recommendations. Identify all paints on shop drawings, together with data describing the methods of application and curing.
- J. Include primer coats or other surface pretreatments where recommended by the manufacturer of the paints.
- K. Use adhesives as recommended by the manufacturers of the materials specified to be laminated or adhered.
- L. Welding shall be of the correct type to minimize permanent distortions of flat surfaces. Remove all welding flux, oxides, and discolorations so that welded areas match the finish of adjacent areas.
- M. Separate dissimilar materials with closed-cell neoprene spacers, or similar, to prevent galvanic action.

1.12 MATERIALS

- A. Aluminum Sheet and Plate: ASTM B 209, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with at least the strength and durability properties of Alloy 5005-H32.
- B. Aluminum Extrusions: ASTM B 221, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with at least the strength and durability properties of Alloy 6063-T5.
- C. Acrylic Sheet: ASTM D 4802, Category A-1 (cell-cast sheet), Type UVA (UV absorbing) as manufactured by one of the following, or approved equal:
 - 1. Acrylite SG.
 - 2. Aristech.
 - 3. Mitsubishi Rayon Co., Ltd.
 - 4. Rohm and Haas.
- D. Translucent Acrylic Sheet: ASTM D 4802, Category A-1 (cell-cast sheet), with Finish 1 (smooth or polished).

- E. Photopolymer: With ultraviolet inhibitors. With 80 shore-D durometer hardness for interior applications and with 90 shore-D durometer hardness for exterior applications. As manufactured by one of the following, or approved equal:
 - 1. Nova Polymer. NovAcryl for interior applications, NovEx for exterior applications.
- F. Polycarbonate Sheet: Of thickness indicated, manufactured by extrusion process, coated on both surfaces with abrasion-resistant coating:
 - 1. Impact Resistance: 854 J/m per ASTM D 256, Method A.
 - 2. Tensile Strength: 62 MPa per ASTM D 638.
 - 3. Flexural Modulus of Elasticity: 2345 MPa per ASTM D 790.
 - 4. Heat Deflection: 129 deg C at 1.82 MPa per ASTM D 648.
 - 5. Abrasion Resistance: 1.5 percent maximum haze increase for 100 revolutions of a Taber abraser with a load of 500 g per ASTM D 1044.
- G. Applied Vinyl: Die-cut characters from vinyl film of nominal thickness of 0.076 mm with pressure-sensitive adhesive backing, suitable for exterior applications.
- H. Clear Tempered Glass: ASTM C 1048, Kind FT, Condition A, Type I, Class 1 (clear), Quality q3, with exposed edges seamed before tempering, and 6 mm thick unless otherwise indicated.
- I. Opaque Acrylic Sheet: ASTM D 4802, Category A-1 (cell-cast sheet), with Finish 1 (smooth or polished), and 6 mm thick unless otherwise indicated; colors as indicated.
- J. Fasteners: Provide screws, bolts, and other fastening devices made from the same material as items being fastened, except provide hot-dip galvanized, stainless-steel, or aluminum fasteners for exterior applications. Provide types, sizes, and lengths to suit installation conditions. Use security fasteners where exposed to view.
 - 1. Machine Screws: comply with Industrial Fastener Institute, use countersunk Phillips flat-head where exposed unless otherwise shown.
- K. Adhesives: Furnish adhesives as specified and as manufactured by one of the following, or approved equal:
 - 1. Two-face Tape:
 - a. 3M VHB Acrylic Foam Tape 4950.
 - b. 3M Double Coated Tape 415 Clear.
 - 2. Silicone-Adhesive: Ready-to-use high performance adhesive:
 - a. General Electric GE1200 sealant, translucent, SCS1201
 - b. Dow Corning 999-A Silicone Building & Glazing Sealant 999
 - 3. Epoxy: Two-component thermosetting epoxy adhesive with 100% solid content:
 - a. 3M DP Scotchweld Adhesives.
 - b. Lord Engineered Adhesives.
- L. Coatings:
 - 1. Acrylic Polyurethane Enamel: For all surfaces noted as "painted", provide aliphatic polyurethane enamel consisting of ultra-violet inhibitors that are lightfast, weather-, abrasion-, and wear-resistant. Provide products with a maximum applied VOC of 0.34 (for latex) or 0.42 (for oil-based) kilograms per liter. Provide products that are Green Seal certified where performance is comparable to higher-VOC products. Provide Eggshell finish with protective clear finish.
 - a. VOC MAP, Matthews Paint.
 - b. Grip-Gard, Akzo Nobel.

2. Translucent Sign Coating: Provide Akzo Nobel Gripflex Intermix Sign Paint, or equal.
 3. Protective finish: For all surfaces noted to receive protective clear finish, apply two coats of clear acrylic polyurethane. Eggshell sheen. Provide coatings compatible with inks or paints applied to surfaces. Provide protective finishes as specified and as manufactured by one of the following, or approved equal:
 - a. VOC MAP Matthews Paint.
 - b. Grip-Gard, Akzo Nobel.
- M. Vinyl Machine-cut Artwork: Provide computer-driven machine-cut letters in thicknesses as specified below, selected from standard colors:
1. Opaque applications:
 - a. 3M 7125 or 7725 series, 0.05 mm cast vinyl.
 - b. Avery A7 Reflective or A9 series, 0.05 mm cast vinyl.
 2. Reflective Applications:
 - a. 3M 680 Series, 0.175 mm cast vinyl.
 - b. Avery A7 Reflective, Engineer Grade, 0.175 mm cast vinyl.
 3. Backlit applications
 - a. 3M 3630 series, 0.076 mm cast vinyl
 - b. Avery A6 Translucent series, 0.076 mm cast vinyl.
 - c. Avery A9 translucent series, 0.058 mm cast vinyl.
- N. Closed-cell PVC Foam Board: Provide lightweight rigid moderately expanded closed cell polyvinyl chloride (PVC) extruded sheet in thicknesses specified, and as manufactured by the following, or approved equal:
1. Sintra, Alcan Composites

1.13 DIMENSIONAL CHARACTERS

- A. Cutout Characters: Provide characters with square-cut, smooth edges. Comply with the following requirements:
1. Acrylic: Thicknesses and colors as shown in the Drawings.
 2. Aluminum Sheet: Thicknesses and colors as shown in the Drawings.
 3. Stainless steel: Thicknesses and finishes as shown in the Drawings.
 4. Vinyl: Pressure sensitive in thicknesses and colors as indicated in the Drawings and Specifications.
 5. Mounting: As indicated in the Drawings for substrates encountered.
- B. Changeable Message Inserts: Fabricate signs to allow insertion of changeable messages in the form of transparent covers with paper inserts printed by Owner.
1. Window (Slotted) Signs (typical at Elementary Schools and other District building areas – confirm with CFISD Project Manager for use at Middle and High Schools)
 2. Shall be open on both ends for an insert by Owner,
 3. Window shall be a non-glare Lexan window, with an exposed color laminate behind in color as selected by Architect.
- C. Changeable Room Inserts: Fabricate signs to allow insertion of changeable messages in the form of transparent covers with acrylic sliding inserts. Text shall read: "IN USE / NOT IN USE"

- D. Tactile and Braille Sign: Manufacturer's standard process for producing text and symbols complying with ADA-ABA Accessibility Guidelines and with ICC/ANSI A117.1. Text shall be accompanied by Grade 2 Braille. Produce precisely formed characters with square-cut edges free from burrs and cut marks. Produce Braille dots with domed or rounded shape.
 - 1. Raised-Copy Thickness: Not less than 0.8 mm.
- E. Subsurface Copy: Apply vinyl copy, in thicknesses as indicated in the Specifications, to back face of clear glass panels, as indicated in the Drawings and Specifications, forming panel face to produce precisely formed opaque image. Image shall be free of rough edges.
- F. Colored Coatings for Acrylic Sheet: For copy and background colors, provide colored coatings, including inks, dyes, and paints, that are recommended by acrylic manufacturers for optimum adherence to acrylic surface and are UV- and water-resistant for five years for application intended.

1.14 FABRICATION

- A. General: Provide signs of configurations indicated.
 - 1. Welded Connections: Comply with AWS standards for recommended practices in shop welding. Provide welds behind finished surfaces without distortion or discoloration of exposed side. Clean exposed welded surfaces of welding flux and dress exposed and contact surfaces.
 - 2. Mill joints to tight, hairline fit. Form joints exposed to weather to exclude water penetration.
 - 3. Preassemble signs in the shop to greatest extent possible. Disassemble signs only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation, in location not exposed to view after final assembly.
 - 4. Conceal fasteners if possible; otherwise, locate fasteners where they will be inconspicuous.
- B. Fabricate signs to requirements indicated for dimensions, design, and thickness and finish of materials. Use metals and shapes of thickness and reinforcement to produce flat surfaces, free of oil canning, and to impart strength for size, design, and application indicated.
- C. Fabricate sign cabinets and frames with reinforced corners, mitered and welded to a hairline fit, with no exposed fasteners. Provide structural reinforcement to prevent racking and misalignment.

1.15 FINISHES, GENERAL

- A. Comply with NAAMM's "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. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

1.16 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm.
- B. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 0.04 mm. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

1.17 STEEL FINISHES

- A. Surface Preparation: Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."
- B. Factory Priming for Painted Finish: Apply shop primer specified below immediately after surface preparation and pretreatment.
 - 1. Shop Primer: Manufacturer's or fabricator's standard, fast-curing, lead- and chromate-free, universal primer, selected for resistance to normal atmospheric corrosion, for compatibility with substrate and field-applied finish paint system indicated, and for capability to provide a sound foundation for field-applied topcoats despite prolonged exposure.
- C. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-enamel finish consisting of prime coat and thermosetting topcoat. Comply with paint manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 0.05 mm.
- D. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - 1. Run grain of directional finishes with long dimension of each piece.
 - 2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
 - 3. Directional Satin Finish: No. 4.
 - 4. Mirror-like Reflective, Non-directional Polish: No. 8.

1.18 SIGNAGE APPLICATIONS

- A. Accessibility Compliance: All signs are required to comply with ADAAG and ANSI/ICC A 117.1 and applicable building codes, unless otherwise indicated; in the event of conflicting requirements, comply with the most comprehensive and specific requirements.
- B. All Signage Types: Unless otherwise indicated:
 - 1. Character Font: Helvetica, Arial, or other sans serif font.
 - 2. Character Case: Upper case only.
 - 3. Background Color: As scheduled.
 - 4. Character Color: Contrasting color.
 - 5. Room numbers and restroom copy shall be accompanied by Grade II braille by means of "VisiTouch Duradot System". Glass or metallic "Durodots" shall have 0.059 inch surface diameter with body of sphere pressure secured below face laminate. Routed boxes or glued on dots are not acceptable.

- C. Room and Door Signs: Provide a sign for every doorway, whether it has a door or not, including offices, classrooms, corridors, lobbies, store rooms, conference rooms mechanical/electrical/utility rooms, and similar open areas for Andre Elementary School and Walker Elementary School in the base bid
1. Sign Type: Flat signs with engraved panel media as specified.
 2. Provide "tactile" signage, with letters raised minimum 1/32 inch and Grade II braille.
 3. Use injection molded panel signs as specified.
 4. Character Height: 5/8 inch, minimum.
 5. Doors: Identify with room numbers to be determined later, not the numbers shown on the drawings; in addition, provide "window" section for replaceable occupant name.
 6. Classroom and Meeting Rooms: Identify with room names and numbers to be determined later, not those shown on the 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 shown on the drawings.
 8. Rest Rooms: Identify with pictograms, the names "MEN" and "WOMEN", room numbers to be determined later, and braille. Shall appear on a minimum six (6) inch square, unobstructed field.
- D. Approved Manufacturers:
1. Signage:
 - a. South Texas Graphic Specialties, Inc., Houston, TX; (713) 467-4499
 - b. Architectural Graphic Products, Houston, Texas; (713) 683-8942
 - c. Esbee Sign Systems
 - d. Intex/United Sign systems
 2. Plastic Laminate:
 - a. Wilsonart International, Temple, TX; (800) 433-3222
 3. Fasteners and Accessories:
 - a. 1/8 inch thick, double-sided foam tape of type recommended to suit application and commercial grade silicone sealant.
- E. Interior Directional, Occupancy, and Informational Signs:
1. Sign Type: Same as room and door signs.
 2. Allow for 8 signs 4 inches high by 16 inches long.
 3. Where suspended, ceiling mounted, or projecting from wall signs are indicated, provide two-sided signs with same information on both sides.
- F. Emergency Evacuation Maps:
1. Allow for one map per lobby and one outside each emergency exit..
 2. Map content to be provided by Owner.
 3. Use clear plastic panel silk-screened on reverse, in brushed aluminum frame, screw-mounted.
- G. Traffic Signs, and Post and Panel Sign for Site Directory / Directional Signage: To match building standards; locate where indicated on the drawings.
1. Signage Materials: 0.080 inch thick aluminum or galvanized steel sign with 1-1/2 inch silk screen upper case letters, copy and border. Signs shall have 1-1/2 inch radius at corners typically. Sizes shall be as shown on drawings or required by authorities having jurisdiction.
 2. Post Materials: Provide in accordance with Section 05 50 00, Metal Fabrications.
 3. Graphics:

- a. Accessibility (“Handicapped Parking”) signs with lettering and graphics as detailed. All work shall comply with local codes, ADA, and TAS standards and requirements.
 - b. “Stop”, “No Parking” and “One Way” signs with lettering and graphics as detailed. All work shall comply with local codes, and standards and requirements of authorities having jurisdiction.
4. Accessories:
- a. Sign Mounting Hardware: Provide sign mounting hardware of galvanized steel of type and size instructed by manufacturer to suit intended use.
 - b. Provide concrete footings of 3,000 psi compressive strength at 28 days, unless noted or directed otherwise.
 - c. Provide all materials required for signage and proper installation.
- H. Fire Department Connection:
1. Signage material similar to Traffic signs- White background with red lettering
 - a. Graphics: FDC Connection
- I. Fire Sprinkler Riser Room:
1. Signage material and attachment similar to Room Identification signage.
 2. Signage material must be weather proof
 3. Graphics: Fire Sprinkler Riser Room
- J. Roof Hatch Signs:
1. Signage material and attachment similar to Room Identification signage.
 2. Signage text to read “Roof Access”. Mount above room sign where roof hatch exists.

PART ? - EXECUTION

1.19 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
- B. Examine walls and partitions for proper backing for directories.
- C. Examine walls and partitions for suitable framing depth if recessed directories will be installed.
- D. Verify that items, including anchor inserts, are sized and located to accommodate signs.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

1.20 INSTALLATION

- A. General: Install directories in locations and at mounting heights indicated on Drawings. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.
- B. Locate signs and accessories as noted below, using mounting methods of types described and complying with fabricator’s written instructions.
 1. Install signs level, plumb, and at heights indicated, with sign surfaces free of distortion and other defects in appearance.

2. Interior Wall Signs With Tactile Copy: Install signs in accordance with the following criteria:
 - a. At single-leaf doors, install sign adjacent to latch side of door. Where a glass sidelight is adjacent to the latch side of the door, install sign on wall surface adjacent to the glass sidelight.
 - b. At double-leaf doors with one active leaf, install sign on the inactive leaf in the center of the leaf, at the height indicated in the Drawings.
 - c. At double-leaf doors with two active leaves, install sign to the right of the right-hand door. Where a glass sidelight is adjacent to the right-hand door, install sign on wall surface adjacent to the glass sidelight.
 - d. Where there is no space at the latch-side of a single-leaf door, or at the right side of double-leaf doors, install signs on nearest adjacent walls.
 - e. Locate signs containing tactile characters so that a clear floor space of 460 mm square (centered on the tactile characters) is provided beyond the arc of the door swing, between the closed position and the 45-degree (half-open) position.
 - f. Locate to allow approach within 75 mm of sign without encountering protruding objects or standing within swing of door.
- C. Wall-Mounted Signs: Comply with fabricator's written instructions except where more stringent requirements apply.
 1. Two-Face Tape: Mount signs to smooth, nonporous surfaces. Do not use this method for vinyl-covered or rough surfaces.
 2. Silicone-Adhesive Mounting: Attach signs to irregular, porous, or vinyl-covered surfaces.
 3. Shim Plate Mounting: Provide 3 mm-thick, concealed aluminum shim plates with predrilled and countersunk holes, at locations indicated, and where other mounting methods are not practicable. Attach plate with fasteners and anchors suitable for secure attachment to substrate. Attach panel signs to plate using method specified above.
 4. Mechanical Fasteners: Use non-removable mechanical fasteners placed through predrilled holes. Attach signs with fasteners and anchors suitable for secure attachment to substrate as recommended in writing by sign manufacturer.
 5. Signs Mounted on Glass: Provide opaque plate on opposite side of glass to conceal mounting materials. Opaque plate shall match material, color, and dimensions of sign.
 6. Blocking: Coordinate partition blocking locations with other trades and the Drawings.
- D. Dimensional Characters: Mount characters using standard fastening methods to comply with fabricator's written instructions for character form, type of mounting, wall construction, and condition of exposure indicated. Provide heavy paper template to establish character spacing and to locate holes for fasteners.
 1. Flush Mounting: Mount characters with backs in contact with wall surface.
- E. If no location is provided, obtain instructions from Owner
- F. If attaching to glass, provide blank rear plate same size and material as sign on back side of glass to conceal tape.
- G. Traffic Signs, and Post and Panel Sign for Site Directory / Directional Signage:
 1. Install sign posts in concrete footings as shown on drawings, with signs set to heights as shown on drawings.
 2. Install signs on posts in accordance with manufacturer's instructions.

1.21 CLEANING AND PROTECTION

- A. After installation, clean soiled sign surfaces according to manufacturer's written instructions. Protect signs from damage until acceptance by Owner.
- B. Protect all adjacent surfaces from damage during installation.
- C. Following installation, remove all traces of visible tapes, adhesives, or wrappings.

END OF SECTION

SECTION 10 26 01 - WALL PROTECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Corner guards.
- B. Wall covering
- C. Fished end caps

1.2 SUBMITTALS

- A. Product Data: Indicate physical dimensions, features, anchorage details, and rough-in measurements.
- B. Samples: Submit two sections of bumper rail, 8 inch long, illustrating component design, configuration, color and finish.
- C. Manufacturer's Instructions: Indicate special procedures, perimeter conditions requiring special attention, and attachment details.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Wall Protection: Named product indicates basis of design.
 - 1. Construction Specialties, Inc (C/S Group): www.c-sgroup.com.
 - 2. Korogard Wall Protection Systems: www.korogard.com.

2.2 COMPONENTS

- A. Construction Specialties – Model SM-20AN (Acrovyn 4000) - Corner Guards – surface mounted: One-piece unit without splices, installed with continuous aluminum retainer clips.
 - 1. Material: High impact Acrovyn 4000.
 - 2. Thickness: min. .078 inch wall thickness.
 - 3. Width of Wings: 3 inches and ¼” corner radius.
 - 4. Styles: Provide 90 degree square corners and wall end protectors, and as indicated on Drawings.
 - 5. Length: full height of wall from finished floor to ceiling height. Dimension varies per wall and ceiling locations.
 - 6. Mounting: Flush mounted extruded aluminum retainers 6063-T6 alloy, nominal .070-inch-thick. The retainers are attached directly to the Gypsum board prior to the wall finish.
 - 7. Fasteners: All fasteners to be non-corrosive and compatible with aluminum retainers. Fasteners provided by corner guard manufacturer.
 - 8. Color as selected by the Architect..

- B. Construction Specialties – Acrovyn high impact 4000 wall covering – Surface mounted: installed with continuous aluminum retainer clips.
 - 1. Material: High impact Acrovyn 4'-0" x 10'-0" rigid sheets.
 - 2. Thickness: min. .040 inch wall thickness.
 - 3. Flame Spread: 25 or less, Smoke development: 450 or less.
 - 4. Length: As shown in construction documents.
 - 5. Mounting: Flush mounted with manufactured standard adhesive and trim at edges.
 - 6. Provide optional aluminum trim.
 - 7. Color as selected by the Architect.

- C. Corner Guards for tile exterior corners in restroom tile areas other than the kitchen area- Extruded one-piece unit without splices, installed integral with tile.
 - 1. Basis of Design: Schluter – Quadec Q 125E
 - 2. Material: Type 304 stainless steel, No. 4 finish.
 - 3. Styles: Provide 90 degree corners and wall end protectors.
 - 4. Size: 1/2 inch x 1/2 inch x full height of ceiling.
 - 5. Length: One piece.

- D. Finished End caps at interior classroom single walls: Extruded aluminum shapes, not less than 0.062 in thick, profile size and finish to match door and window framing members. One piece frame to extend from floor to ceiling. Reference specification section 08 11 16 Aluminum doors and frames for finished end to match framing system.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install components in accordance with manufacturer's instructions, level and plumb, secured rigidly in position to wall.
- B. Surface preparation: Prior to installation, clean substrate to remove dirt, debris and loose particles.
- C. Perform additional preparation procedures as required by manufacturer's instructions. B. Protection:
- D. Take all necessary steps to prevent damage to material during installation as required in manufacturer's installation instructions.
- E. Install the work of this section in strict accordance with the manufacturer's recommendations using approved adhesive.
- F. Temperature at the time of installation must be between 65-75°F (18-24°C) and be maintained for at least 48 hours after the installation to allow for proper adhesive set-up.
- G. Relative humidity shall not exceed 80%.
- H. Do not expose wall covering to direct sunlight during or after installation. This will cause the surface temperature to rise, which in turn will cause bubbles and delamination

3.2 TOLERANCES

- A. Maximum Variation From Required Height: 1/4 inch.
- B. Maximum Variation From Level or Plane For Visible Length: 1/4 inch.

END OF SECTION

SECTION 10 28 00 - TOILET ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Toilet room accessories.
 - 2. Hand dryers.
 - 3. Underlavatory guards.
 - 4. Custodial accessories.
- B. Owner-Furnished Material: As scheduled on Drawings; all Owner-furnished items are to be installed by Contractor.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include the following:
 - 1. Construction details and dimensions.
 - 2. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
 - 3. Material and finish descriptions.
 - 4. Features that will be included for Project.
 - 5. Manufacturer's warranty.
- B. Samples: Full size, for each accessory item to verify design, operation, and finish requirements.
 - 1. Approved full-size Samples will be returned and may be used in the Work.
- C. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
 - 1. Identify locations using room designations indicated.
 - 2. Identify products using designations indicated.

1.3 INFORMATIONAL SUBMITTALS

- A. Warranty: Sample of special warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For toilet and bath accessories to include in maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Source Limitations: For products listed together in the same Part 2 articles, obtain products from single source from single manufacturer.

- 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.

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. Special Mirror Warranty: Manufacturer's standard form in which manufacturer agrees to replace mirrors that develop visible silver spoilage defects and that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: 15 years from date of Substantial Completion.
- B. Special Hand Dryer Warranty: Manufacturer's standard form in which manufacturer agrees to replace dryers that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: 5 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- 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. Structural Performance: Design accessories and fasteners to comply with the following requirements:
 - 1. Grab Bars: Installed units are able to resist 250 lbf concentrated load applied in any direction and at any point.

2.2 MATERIALS

- A. Stainless Steel: ASTM A 666, Type 304, 0.031-inch minimum nominal thickness unless otherwise indicated.
- B. Brass: ASTM B 19, flat products; ASTM B 16/B 16M, rods, shapes, forgings, and flat products with finished edges; or ASTM B 30, castings.
- C. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.036-inch minimum nominal thickness.
- D. Galvanized-Steel Sheet: ASTM A 653/A 653M, with G60 hot-dip zinc coating.
- E. Galvanized-Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.

- F. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.
- G. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).
- H. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.
- I. ABS Plastic: Acrylonitrile-butadiene-styrene resin formulation.

2.3 TOILET ROOM ACCESSORIES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide products scheduled on Drawings or comparable products by one of the following:
 - 1. A & J Washroom Accessories, Inc.
 - 2. American Specialties, Inc.
 - 3. Bobrick Washroom Equipment, Inc.
 - 4. Bradley Corporation.
 - 5. General Accessory Mfg. Co. (GAMCO)
 - 6. McKinney/Parker
 - 7. Watrous, Inc.

2.4 HAND DRYERS

- A. Manufacturers: Subject to compliance with requirements, provide Bradley model 2902-280000 or Saniflow model M06AF-UL.
- B. Standard Air Dryer:
 - 1. Mounting: Surface mounted, with downward fixed nozzle.
 - 2. Operation: Proximity sensor activated and cut-off.
 - 3. Cover Material and Finish: Stainless steel with brushed finish, attached to mounting plate with tamper-resistant screws.
 - 4. Electrical Requirements: 120 V, single phase, 60 Hz..
 - 5. Heater: 900 W at full power.
 - 6. Fan/Heater Control: Field-adjustable down to approximately half-speed with corresponding reduction in heat output.

2.5 UNDERLAVATORY GUARDS

- A. Underlavatory Guards: As scheduled on Drawings.

2.6 CUSTODIAL ACCESSORIES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide products scheduled on Drawings or comparable products by one of the following:
 - 1. A & J Washroom Accessories, Inc.
 - 2. American Specialties, Inc.
 - 3. Bobrick Washroom Equipment, Inc.
 - 4. Bradley Corporation.
 - 5. General Accessory Mfg. Co. (GAMCO)
 - 6. McKinney/Parker
 - 7. Watrous, Inc.

2.7 FABRICATION

- A. General: 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, when tested according to ASTM F 446.

3.2 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
- B. Remove temporary labels and protective coatings.
- C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

END OF SECTION

SECTION 10 44 00 - FIRE PROTECTION SPECIALTIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Fire extinguisher cabinets.
- B. Fire extinguishers and brackets
- C. Accessories.

1.2 SUBMITTALS

- A. Product Data: Provide extinguisher operational features.
- B. Manufacturer's Installation Instructions: Indicate special criteria and wall opening coordination requirements.
- C. Maintenance Data: Include test, refill or recharge schedules and re-certification requirements.

1.3 EXTRA STOCK

- A. Provide 6 extra 10 lb Fire extinguishers and hanging brackets for each elementary school above and beyond the number of fire extinguishers required in the contract documents.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Fire Extinguisher Cabinets and Accessories:
 - 1. JL Industries, Inc: www.jlindustries.com.
 - 2. Larsen's Manufacturing Co: www.larsensmfg.com.
 - 3. Potter-Roemer: www.potterroemer.com.
 - 4. Williams Brothers: www.williamsbrothers.com.
 - 5. Substitutions: See Section 01 25 00 – Substitution Procedures.

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 Underwriters Laboratories Inc. for the purpose specified and indicated.
- B. Fire Extinguishers: Powder coated steel tank, with pressure gage. 10 pound, typical.

2.3 FIRE EXTINGUISHER CABINETS

- A. Metal: Formed primed steel sheet; 0.036 inch thick base metal.
- B. Cabinet Configuration: Semi-recessed type.
 - 1. Size: 24 inches x 9-1/2" x 6 inches inside box dimension.
 - 2. Trim: rolled, 2-1/2 inch wide face.
 - 3. Form cabinet enclosure with right angle inside corners and seams. Form perimeter trim and door stiles.
 - 4. Box Construction: Double wall of 18 gauge cold-rolled steel with baked acrylic enamel finish.
- C. Door: 0.036 inch thick stainless steel door and frame reinforced for flatness and rigidity; lock with safety-pull access. Provide roller type catch, handle and silk screen lettering "Fire Extinguisher" in red color, unless directed otherwise by Architect.
- D. Hardware: Continuous concealed piano hinge of constructed of material which matches door and trim material. Satin finish pull handle with self-adjusting roller catch.
- E. Finish of Exterior: Stainless steel.
- F. Finish of Interior: Standard
- G. Cabinet Mounting Hardware: Appropriate to cabinet. Pre-drill for anchors.
- H. Weld, fill, and grind components smooth.
- I. Finish of Cabinet Exterior Trim and Door: Stainless Steel.
- J. Finish of Cabinet Interior: White enamel.
- K. Provide one approved 10# fire extinguisher for each cabinet.

2.4 ACCESSORIES

- A. Extinguisher Brackets: Formed steel, chrome-plated.
- B. Graphic Identification: FIRE EXTINGUISHER, decal on door glazing.
- C. Provide one bracket for each fire extinguisher not scheduled to be in a cabinet.

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. Install in accordance with manufacturer's instructions.

- B. Secure rigidly in place.
- C. The Fire extinguishers locations shown on the plans are recommendations. The Contractor will meet with the Fire Marshall for final locations.

END OF SECTION

SECTION 10 51 00 - METAL LOCKERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Metal athletic lockers.
- B. Metal Art Room lockers.

1.2 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Wood blocking and nailers.

1.3 SUBMITTALS

- A. Product Data: Provide data on locker types, sizes and accessories.
- B. Shop Drawings: Indicate locker plan layout, numbering plan.
- C. Samples: Submit two samples 3 x 6 inches in size, of each color scheduled; applied to specified base metal.
- D. Manufacturer's Installation Instructions: Indicate component installation assembly.
- E. Locker/Lock Schedule: Manufacturer shall furnish the Owner upon Substantial Completion a schedule for all lockers. The schedule shall contain the locker number, serial number of the lock installed, key number, or combinations, as applicable, for each locker. Furnish the schedule in spread-sheet form, i.e. Excel, etc. Furnish schedule in three (3) hard copies and on flash drive. This information is to be transmitted to CFISD Maintenance Department. Do not distribute to campus staff.
- F. Close-Out Submittals:
 - 1. Updated As-Built drawings.
 - 2. Manufacturer contact names and addresses.
 - 3. Product and accessory model numbers and contact names/addresses for future re-ordering of parts by Owner.

1.4 MOCK-UP

- A. Provide mock-up of one full size locker in selected colors.
- B. Locate where directed.
- C. Approved mock-up may remain as part of the Work.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect locker finish and adjacent surfaces from damage.

- 1.6 WARRANTY - Warrant the work specified herein against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials or workmanship.
- A. Athletic Lockers: ten (10) years.
 - B. Defects shall include, but not be limited to, the following:
 - 1. Rapid deterioration of finish.
 - a. Loose or missing parts.
 - 1) Non-functioning components and mechanisms.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Specifications are based on products of Republic Storage Systems Co., Inc., Canton, OH. Manufacturers listed whose products meet or exceed the specifications are approved for use on the Project:
- B. Lockers: Fully Welded
 - 1. Art Metal Products Company, Fort Knox Storage Co., Arlington Heights, IL
 - 2. Lyon Workspace Products: www.lyonworkspace.com.
 - 3. Penco Products, Inc: www.pencoproducts.com.
 - 4. DeBourgh Mfg. Co.: www.debourgh.com.
 - 5. Interior/Medart Locker Company.

2.2 MATERIALS

- A. Sheet Steel: ASTM A 653/A 653M SS Grade 33/230, with G60/Z180 coating, stretcher leveled; to the following minimum thicknesses:
 - 1. Body and Shelf: 24 gage, 0.024 inch.
 - 2. Door Outer Face: 18 gage, 0.048 inch.
 - 3. Door Inner Face: 20 gage, 0.036 inch.
 - 4. Door Frame: 16 gage, 0.060 inch.
 - 5. Hinges: 14 gage, 0.075 inch.
 - 6. Base: 20 gage, 0.036 inch.
 - 7. Sloping Top: 20 gage, 0.036 inch.
 - 8. Trim: 20 gage, 0.036 inch.
- B. Accessories for Each Locker: All single, double and triple tier lockers shall have one double-prong (single prong in 9 inch width) back hook and two (2) single-prong wall hooks in each compartment. All hooks shall be made of steel.

2.3 LOCKER UNITS

- A. Configuration: As indicated.
- B. Mounting: Surface mounted, free-standing.
- C. Base: Metal base.

1. Base Height: 4 inch.
- D. Tops:
1. Athletic Wall Lockers: Sloped metal with closures.
 2. Athletic Free-Standing Lockers: Flat top with 1 inch thick HDPE panel fastened to top of lockers.
 3. Art Room Wall Lockers: Flat top with 1 inch thick HDPE panel fastened to top of lockers.
- E. Locking: Equipped with integrated combination lock.
- F. Class: Conventional.
- G. Locker Body: Formed and flanged; with steel stiffener ribs; electric spot welded.
- H. Frames: Formed channel shape, welded and ground flush, welded to body, resilient gaskets and latching for quiet operation.
- I. Doors:
1. Athletic Lockers: Perforated doors fabricated from one piece 0.075-inch nominal-thickness steel sheet with manufacturer's standard diamond perforations; formed into channel shape with double bend at vertical edges and with right-angle single bend at horizontal edges and latch point (bottom) and right-angle single bend at remaining edges for box lockers.
 - a. Reinforcement: Manufacturer's standard reinforcing angles, channels, or stiffeners for doors more than 15 inches wide; welded to inner face of doors.
 2. Art Room Lockers: Solid doors fabricated of welded, hollow double pan, sandwich construction, 1-3/16 inch thick; channel reinforced top and bottom with intermediate stiffener ribs, grind and finish edges smooth.
 - a. Louvered vents: No fewer than three louver openings at top and bottom.
- J. Hinges: Shall be two (2) inch high, 5-knuckle, full loop, tight pin style to be securely welded to the frame and riveted to the inside of the door flange. Hinges shall be attached with two (2) rivets. Doors 42 inches high and less shall have two (2) hinges. Doors over 42 inches high shall have three (3) hinges.
- K. Pre-Locking Device: Lockers shall be equipped with a positive automatic pre-locking device whereby the locker may be locked while the door is open and then closed without unlocking and without damaging the locking mechanism.
- L. Name Plates: Provide square shaped metal frame for paper inserts by others.
- M. Form recess for operating handle and locking device.
- N. Finish edges smooth without burrs.
- O. Provide solid end panels and filler strips.
- P. ADA Compliant Lockers: Handicap lockers shall have recessed handles and shall be single tier or the lower opening of a double tier locker. Doors assigned for handicapped use shall have an appropriate accessibility symbol sign.

2.4 FINISHING

- A. Clean, degrease, and neutralize metal; prime and finish with one coat of baked enamel.
- B. Paint locker units 1 color in each room, as selected.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that prepared bases are in correct position and configuration.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install lockers plumb and square.
- C. Place and secure on prepared base.
- D. Secure lockers with anchor devices to suit substrate materials. Minimum Pullout Force: 100 lb.
- E. Bolt adjoining locker units together to provide rigid installation.
- F. Install end panels, filler panels, and sloped tops.
- G. Install accessories.
- H. Replace components that do not operate smoothly.

3.3 CLEANING

- A. Clean locker interiors and exterior surfaces.

END OF SECTION

SECTION 10 56 13 - METAL STORAGE SHELVING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Metal four-post storage shelving.

1.2 SUBMITTALS

- A. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Rated uniform shelf loads.
 - 2. Details of shelving assemblies, including reinforcement.
 - 3. Accessories.
 - 4. Substrate preparation instructions and recommendations.
 - 5. Storage and handling requirements and recommendations.
 - 6. Installation methods.
 - 7. Maintenance methods.
- B. Test Reports: Provide independent agency test reports documenting compliance with specified structural requirements.
 - 1. In lieu of test reports, detailed drawings stamped and sealed by a Professional Engineer licensed in the State in which the Project is located will be acceptable.
- C. Shop Drawings: Indicate location, type, and layout of shelving, including lengths, heights, and aisle layout, and relationship to adjacent construction.
 - 1. Indicate methods of achieving specified anchoring requirements.
- D. Selection Samples: For each finish product specified, color chips representing manufacturer's full range of available colors and finishes.

1.3 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Inspect for dents, scratches, or other damage. Replace damaged units.
- B. Store in manufacturer's unopened packaging until ready for installation.
- C. Store under cover and elevated above grade.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Four Post Shelving:

1. Dixie Shelving Company, Houston, Texas.
2. Inco Metal Products.
3. List Industries, Inc., Deerfield Beach, Florida.
4. Lyon metal Products, inc., Aurora, Illinois.
5. Montel, Inc., Melbourne, Florida.
6. Penco Products, inc., Oaks, Pennsylvania.
7. Republic Storage Systems Co., Inc., Canton, Ohio.

2.2 SHELVING - GENERAL

A. Shelving: Provide products tested to comply with ANSI MH28.1 for design criteria, lateral stability, shelf connections, and shelf capacity.

B. Anchors: Provide anchoring hardware to secure each shelving unit to floor and wall.

1. Provide hardware of type recommended by manufacturer for substrate.

2.3 FOUR POST SHELVING

A. Four Post Shelving: Steel post-and-beam type with sway bracing, shelving brackets, shelving surfaces, and accessories as specified.

1. Unit Width: As indicated.
2. Shelf Capacity: 400 lbs uniformly distributed load.
3. Shelf Deflection: L/140, maximum, under rated uniform load.
4. Adjustability of Shelving: Continuous along length of post.
5. Shelf Depth: 16 inches, typical; 24 inches where indicated.
6. Shelves per Unit: 7.
7. Unit Height: 84 inches, overall, maximum.
8. Finish: Baked enamel, medium gloss.
9. Color: As selected by Architect from manufacturer's standard range.
10. Provide single-face and double-face units where indicated.

B. Posts and Beams: Formed sheet members; perforations exposed on face of members are not acceptable.

1. Metal Thickness: 16 gage, 0.0598 inch.
2. Post Shape: Tee intermediate posts, angle end posts forming corners.
3. Post Face Width: 2 inches, maximum.
4. Connecting Hardware: Manufacturer's standard.

C. Solid-Type Shelves:

1. Steel Sheet: Nominal thickness as required for load-carrying capacity per shelf.
2. Fabricate fronts and backs of shelves with box-formed edges, with corners lapped and welded.

D. Bracing: Formed sheet members.

1. Back Sway Bracing: Pair of straps at back of each unit, bolted or riveted to uprights.

2. Side Sway Bracing: Par of straps at each side of each unit, bolted or riveted to uprights.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that substrate is level and that clearances are as specified.
- B. Verify that walls are suitable for shelving attachment.
- C. Do not begin installation until substrates have been properly prepared.
- D. 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. Anchor and reinforce as specified, as indicated on drawings, and as recommended by manufacturer.
- C. Install shelving with shelf surfaces level and vertical supports plumb; adjust feet and bases as required.
- D. Out-Of-Square Tolerance - Four Post Shelving: Maximum of 1/8 inch difference in distance between bottom shelf and canopy top, measured along any post in any direction.

3.4 CLEANING

- A. Clean shelving and surrounding area after installation.

3.5 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 10 73 26 – ALUMINUM WALKWAY COVERINGS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Prefabricated Aluminum walkway covers.

1.2 REFERENCES

- A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels ; 2005.
- B. ASTM B 209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate ; 2006
- C. ASTM C 1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink) ; 2007.
- D. ASTM D 1187 - Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal ; 1997 (Reapproved 2002).
- E. AWS D1.2/D1.2M - Structural Welding Code - Aluminum ; 2003 and errata.
- F. NAAMM AMP 500 through 505 - Metal Finishes Manual ; 1988
- G. NOMMA - Guideline 1: Joint Finishes ; current edition.

1.3 DELEGATED DESIGN

- A. Refer to Section 01 33 00 for information regarding delegated design submittals.
- B. As a performance specification, the criteria for the solution of structurally sound walkway cover indicated on the Drawings or specified herein are the sole purpose of defining the design intent and performance requirements. The details shown are intended to emphasize the acceptable profiles and performance requirements for this Project. To avoid any misunderstanding or lack of interpretation, the Contractor is hereby advised that the responsibility for the walkway cover is totally his and that designs and resolutions proposed in the shop drawings, structural calculations, and related documentation shall be demonstrated throughout the Work and warranty period specified or required.
- C. Design proposal submissions which follow exactly the details indicated on the Drawings for the walkway cover will not relieve the Contractor of his responsibility for the design, fabrication, erection, or performance of the Work of this Section.
- D. In the event of a controversy over the design, the decision of the Architect will take precedence.

1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design framing, including comprehensive engineering analysis by a licensed registered Texas structural engineer, using performance requirements and design criteria indicated.
- B. General: Design, fabricate, and install walkway covers to withstand loads from gravity, wind, ponding, drift, and structural movement, including thermally induced movement; and to resist, without failure, other conditions of in-service use, including exposure to weather.
- C. Structural Performance: Provide walkway covers capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.
 - 1. Wind Loads: Determine loads based on the following minimum design wind pressures:
 - a. Uniform pressure, acting upward or downward.
 - b. Basic Wind Speed: 110 mph 3-second gust, Exposure B, Importance Factor 1.0, or as indicated on Structural drawings, whichever is greater.
 - c. System shall be designed in accordance with FM Global I-90 wind uplift requirements and any other applicable building codes.
 - d. System shall also be designed to comply with Underwriters Laboratories Class 'A' Fire Rating requirements.
 - 2. Thermal Movements: Provide walkway covers 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, tearing of fabric, 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 deg F , ambient; 180 deg F , material surfaces.

1.5 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, for submittal requirements.
- B. Product Data: Include styles, material descriptions, construction details, fabrication details, dimensions of individual components and profiles, hardware, fittings, mounting accessories, features, finishes, and operating instructions for awnings.
- C. Shop Drawings: Show location and extent of walkway covers. Include elevations, sections, and details not shown in Product Data. Show materials, fabrication, dimensions, mounting heights, connections, anchorages, installation details, attachments to other work, operational clearances, and relationship to adjoining work. Show colors and graphic layout and content.
 - 1. Show locations for blocking, reinforcement, and supplementary structural support to be provided by others.
 - 2. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation. Calculate requirements for supporting walkway covers. Verify capacity of members and connections to support loads and verify loads, point reactions, and locations for attachment of awnings to structure with those indicated on Drawings.
- D. Samples for Verification: For each of the following products and for the full range of color, texture, and pattern variations required, prepared on Samples of size indicated below. If finishes involve normal color and texture variations, include sample sets showing the full range of variations expected.

1. Provide actual material finish sample: Not less than 6-inch lengths.

E. Welding certificates.

F. Qualification Data: For fabricator and professional engineer.

G. Research/Evaluation Reports: For anchors and fasteners.

H. 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.

1.6 QUALITY ASSURANCE

A. 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.

B. Source Limitations: Obtain walkway covers through one source from a single manufacturer.

C. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.2, "Structural Welding Code - Aluminum."

1.7 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit installation of walkway covers in exterior locations to be performed according to manufacturers' written instructions and warranty requirements.

B. Field Measurements: Where awning installation is indicated to fit to other work, verify dimensions of other work by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for fenestration operation throughout the entire operating range. Notify Architect of discrepancies. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.8 WARRANTY

A. Provide product/contractor one-year warranty from date of substantial completion date.

PART 2 - PRODUCTS

2.1 APPROVED MANUFACTURERS

A. Manufacturers listed whose products meet or exceed the specifications are approved for use on this Project.

1. Avadek Walkway Cover Systems & Canopies, Houston, TX
2. AAPCO Protective Covers
3. Airvent Remodeling & Design Center
4. American Aluminum Industries, Inc.
5. American Walkway Covers, LLC
6. "Span Deck", Architectural Metal Systems

7. Atlas Custom Metals
8. Berridge Manufacturing Company
9. Childers Carports & Structures, Inc.
10. Dittmer Architectural Aluminum
11. Mapes Industries, Inc.
12. Peachtree Protective Covers, Inc.
13. Perfection Architectural Systems, Inc.
14. Superior Metal Products Co.
15. Texas Aluminum Industries, Inc.

2.2 ALUMINUM WALKWAY COVERS

- A. Aluminum shapes shall be sized and connections designed to meet or exceed specific project design load requirements, and as indicated in the drawings.
- B. Aluminum: 6063-T6 Alloy Extruded aluminum.
- C. Flashing: 0.040 inch aluminum, ASTM B 209; 0.040 inch.
- D. Horizontal U-Beams and vertical tube columns shall be sizes engineered by the manufacturer to suit application, intended use, and requirements of building code authorities having jurisdiction, and shall be attached with concealed fasteners.
- E. Provide concealed drainage from deck into drawings.
- F. Provide bird screens at underside of cover to prevent nesting.

2.3 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
 1. For aluminum components, provide type and alloy as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.
- B. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.
- C. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- D. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.

2.4 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipment.

- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- D. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

2.5 ALUMINUM FINISHES

- A. Mechanical Finish: sand top components in one direction only, parallel to length of railing, with 120- and 320-grit abrasive. After installation, polish railings with No. 0 steel wool immersed in paste wax, then rub to a luster with a soft dry cloth.
- B. Superior-Performance Organic Finish: Three-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat in accordance with Section 05 05 00. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 1. Color: To match existing metal coping and roof color.

2.6 FABRICATION

- A. General: Fabricate units 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. Assemble units in the shop 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 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 will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate. Locate weep holes in inconspicuous locations.
- F. Cut, reinforce, drill, and tap as indicated to receive bolts, screws, and similar items.
- G. Connections: Fabricate units with welded connections unless otherwise indicated.
- H. Manufacturer shall design structure to withstand walking on top, heavy hail, and winds in the configurations shown on drawings.
- I. Provide concealed drainage from deck into columns. Fill downspouts columns with grout to the discharge level to prevent standing water. Install downspout deflectors after grouting.
- J. Fabricate flashing to prevent leakage of water between canopy and adjacent structures, where applicable.

- K. Roof Deck: Shall be of size and depth indicated or as instructed by the manufacturer to suit application, intended use, requirements of building code authorities having jurisdiction, and shall interlock in a homogeneous structural unit, with joint designed and fabricated into a structurally rigid shape which is self flashing.
- L. Expansion Joints: Provide expansion joints as required. Expansion joints shall have no metal to metal contact.
- M. Welded Connections: Comply with American Welding Society Code. Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
 - 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 flux immediately.
 - 4. At exposed connections, finish exposed welds to comply with NOMMA's "Joint Finishes" for Type 2 welds: completely sanded joint, some undercutting and pinholes okay.
- N. Mechanical Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
 - 1. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method.
- O. Bend members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- P. Close exposed ends of hollow members with prefabricated end fittings.
- Q. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect members to other work unless otherwise indicated.
- R. Provide inserts and other anchorage devices for connecting units to concrete or masonry work. Fabricate anchorage devices capable of withstanding design loads. Coordinate anchorage devices with supporting structure.
- S. For posts set in concrete, provide steel sleeves not less than 6 inches long with inside dimensions not less than 1/2 inch greater than outside dimensions of post, with metal plate forming bottom closure.
- T. Provide closures at the spaces between each deck flute and each beam on the underside of the canopy to prevent birds to roost on the beams.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for supporting members, blocking, inserts, installation tolerances, and other conditions affecting performance.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. General: Install walkway covers at locations and in position indicated, securely connected to supports, free of rack, and in proper relation to adjacent construction. Use mounting methods of types described and in compliance with Shop Drawings and fabricator's written instructions.
- B. Install walkway covers after other finishing operations, including joint sealing and painting, have been completed.
- C. Weld frame connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.
 - 1. Field Welding: 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. Anchoring to In-Place Construction: Use anchors, fasteners, fittings, hardware, and installation accessories where necessary for securing awnings to structural support and for properly transferring load to in-place construction.
- E. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with a heavy coat of bituminous paint.
- F. Coordinate walkway cover installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed exterior wall and roof assemblies.
- G. Connections: Connect motorized operators to building electrical system.
- H. Fasten canopy louver blades to rafters with #8 by 1/2-inch stainless steel screws.
- I. Fasten beam to ends of rafters with concealed clips.
- J. Heliarc weld rafters to wall mounting plates.
- K. Erect canopy after all concrete and masonry in vicinity is complete and washed down.
- L. Install rain caps over draining sections of the deck.
- M. Downspouts columns shall be filled with grout to the discharge level to prevent standing water.
- N. Downspout deflectors shall be installed after grouting.

3.3 CLEANING AND PROTECTION

- A. Clean walkway cover surfaces after installation, according to manufacturer's written instructions.

- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer that ensure that walkway covers are without damage or deterioration at time of Substantial Completion.
- C. Replace damaged components that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

END OF SECTION

SECTION 11 31 00 - RESIDENTIAL APPLIANCES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Furnish and install the following appliances:
 - 1. Dishwasher
 - 2. Ice machine
 - 3. Refrigerator

1.2 SUBMITTALS

- A. Product Data:
 - 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 instructions.

PART 2 - PRODUCTS

2.1 APPLIANCES AND MANUFACTURERS

- A. Break room dishwasher: ADA Compliant
 - 1. Features:
 - a. Energy Star® Certified.
 - b. Cycle memory, last cycle recall
 - c. Number of racks -2, Adjustable Upper Rack
 - d. ADA compliant
 - e. Quiet cleaning performance
 - f. Stainless Steel Tub, 24" tall
 - g. Front located controls, optical level rinse aid indicator
 - h. Number of wash levels - 6
 - i. Nylon rack material with utility basket
 - j. Heated Dry, 12 hour delay
 - k. 2-year parts and labor warranty
 - 2. Color: White
 - 3. 23-1/2" wide x 24" deep x 32-1/2" high
 - 4. Water Requirements: Hot water line with 20-120 psi water pressure, 120 degree F at dishwasher.
 - 5. Electrical Requirements: 120 volts – 60 Hz, AC only, 15 or 20 amps. Fused electrical supply. Wiring must be 2 wire with ground
 - 6. Approved Product/Manufacturer: Model WDF550SAJ(S) white outer Whirlpool™, or Architect approved equal.
- B. Break room ice maker: ADA Compliant
 - 1. Features:

- a. Produces top hat ice cubes
 - b. Up to 55 lbs of ice produced in 24 hours
 - c. Energy Star® Qualified.
 - d. R-134a refrigerant (4.2 oz. / 120 g)
 - e. Heat Rejection: 1900 BTU/hr
 - f. Ambient temperature range: 45 – 100°F
 - g. Water temperature range: 45 – 95°F
 - h. Water pressure: 7 – 113psig
 - i. Easily disassembled for cleaning
 - j. Heat rejection 1900 btus
 - k. Include HS-5061 drain pump assembly
 - l. 2-year parts and labor warranty
 - m. 1-year: parts and labor warranty on HS-5061 Drain Pump Assembly
2. Color: White
 3. 15" wide x 23" deep x 31-1/2" high
 4. Electrical Requirements: 3.8 amps, 15 amp max fuse, 115v/60/1 6ft cord with NEMA 5-15 plug. Voltage range 104-127V
 5. Approved Product/Manufacturer: Model AM-50BAJ-AD Top hat cuber icemaker, or Architect approved equal.
- C. Clinic Refrigerator: ADA Compliant
1. Features:
 - a. 18.2 Cu. Ft., Refrigerator. Capacity: 13 Cu. Ft., Freezer Capacity: 5 Cu. Ft.
 - b. Frameless glass shelves
 - c. Energy Star® Qualified.
 - d. Crisper bins
 - e. No water dispenser
 - f. 1-year: parts and labor warranty
 2. Color: White
 3. 30" wide x 33-1/2" deep x 65-7/8" high
 4. Electrical Requirements: 15, 20A amp max fuse, 60 Htz., 115 Volts
 5. Approved Product/Manufacturer: Model WRT318FZDM Top freezer refrigerator by Whirlpool, or Architect approved equal.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas where appliances are to be installed to ensure proper opening sizes and that areas are ready to receive appliance installation.
- B. Ensure that proper utilities are in place.

3.2 INSTALLATION

- A. Install all appliances and equipment in accordance with manufacturer's printed instructions.

3.3 ADJUSTING AND CLEANING

- A. Adjust appliances and equipment for proper operation.

- B. Clean appliances and equipment of dirt, dust, fingerprints and markings detrimental to good appearance.

END OF SECTION

SECTION 11 43 55 - ICE MACHINES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Ice Machines
- B. Related Work Described Elsewhere: Utility hook-up to equipment is described in Plumbing and Electrical Sections of these Specifications; cooperate as necessary with all other trades to ensure proper and adequate provision for the required utility sizing and locations.

1.2 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is an authorized representative of the ice machine manufacturer for both installation and maintenance of appliances required for this Project.
- B. Product Options: Drawings indicate sizes, profiles, and dimensional requirements of ice machines and are based on the specific types and models indicated. Other manufacturers' appliances with equal performance characteristics may be considered. Refer to Division 1 Section "Substitutions."
- C. Electrical Equipment: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.
- D. UL and NEMA Compliance: Provide electrical components required as part of residential appliances that are listed and labeled by UL and that comply with applicable NEMA standards.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Product Data: For each ice machine, indicating product specifications and options
- C. Operation and Maintenance Instructions: For each ice machine.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
- B. Deliver ice machines only after utility rough-in is complete and construction in the spaces to receive equipment is substantially complete and ready for installation.
- C. Protect ice machines before, during, and after installation, including the installed work and materials of all other trades.
- D. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Architect and at no additional cost to the Owner.

1.5 WARRANTY

- A. Section 01 70 00 - Execution and Closeout requirements: Product warranties and product bonds.
- B. Manufacturer's standard warranty agreeing to repair or replace ice machines that fail in material or workmanship within the specified warranty period.
 - 1. Warranty Period: 3 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 ICE MACHINES

- A. Manufacturers: Subject to compliance with requirements, manufacturers include, but are not limited to, the following:
 - 1. Hoshizaki Ice Machines, www.hoshizakiamerica.com.
 - 2. Manitowoc, www.manitowocice.com.
- B. Icemakers: Types scheduled on Drawings.

2.2 FINISHES

- A. Colors: As selected from manufacturer's standard colors.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Review manufacturers installation instructions and notify Architect in the event of discrepancies; do not proceed with installation until all such discrepancies have been resolved.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions and with requirements of authorities having jurisdiction.
- B. Anchor equipment securely in place in accordance with manufacturer's instructions.
- C. Built-in Equipment: Securely anchor units to supporting cabinets or countertops with concealed fasteners. Verify that clearances are adequate for proper functioning and rough openings are completely concealed.
- D. Sequence installation to accommodate required utility connections.
- E. Touch-up surfaces damaged during installation. Replace damaged components that cannot be satisfactorily repaired.

3.3 ADJUSTING

- A. Section 01 70 00 - Execution and Closeout Requirements: Testing, adjusting, and balancing.
- B. Test ice machines to verify proper operation. Make necessary adjustments.
- C. Verify that accessories required have been furnished and installed.

3.4 CLEANING

- A. Section 01 71 00 - Execution and Closeout Requirements: Final cleaning.
- B. Remove packing material from ice machines and leave units in clean condition, ready for operation.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain ice makers.

END OF SECTION

SECTION 11 60 40 - STAGE CURTAINS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Stage curtains for the Black Box Theater.

1.2 REFERENCES

- A. Published specification standards, tests or recommended methods of trade, industry or governmental organizations apply to Work in this section where cited below:
 1. National Fire Protection Agency (NFPA)
 2. American National Safety Institute (ANSI),
 3. American Society of Testing and Materials (ASTM),
 4. Occupational Safety and Health Administration (OHSA),
 5. Underwriters Laboratories (UL),
 6. Entertainment Technicians Certification Program (ETCP).

1.3 RESPONSIBILITY AND RELATED WORK

- A. The drawings convey general system concepts. The Installer is responsible for making the field measurements necessary to establish exact locations, relationships, load capacities necessary for the installation of these systems. Coordinate the work with the General, Electrical and other related contractors as stated in Part 1.4, and the scheduled work of other trades.
- B. Supply accessories and minor equipment items needed for a complete system, even if not specifically mentioned in these Specifications or on the associated Drawings, without claim for additional payment.
- C. Notwithstanding any detailed information in the Contract Documents, it is the responsibility of the Installer to supply systems in full working order. Notify the Architect of any discrepancies in part numbers or quantities before bid. Failing to provide such notification requires Installer to supply items and quantities according to the intent of the Specifications and associated Drawings without claim for additional payment.
- D. Obtain all permits necessary for the execution of any work pertaining to the installation, or any operation by the Owner including any associated charges or fees.
- E. Execute all work in accordance with all Standard Authorities listed above, and all applicable State and Local codes, ordinances, and regulations. If a conflict develops between the contract document and the appropriate codes and is reported to the Architect prior to bid opening, the Architect will prepare the necessary clarification. Where a conflict is reported after contract award, propose a resolution of the conflict and, upon approval, perform work.
- F. Flame proofing and Documentation of Curtain Fabrics:

1. Provide inherently flame retardant or chemically flame proofed fabric. Chemical flame proofing formula and process must adhere to Bureau of Standards U.S. Department of Commerce. Once fabric is processed, it will pass such tests as are required by the Fire Marshall of the local fire department, the Owner, and any other authority having jurisdiction.
2. A certificate for each curtain is required to be provided to the Owner. This certificate clearly indicates: the name of the Stage Curtain (sub) Supplier, the name and color of the fabric, the name of the Company providing flame proofing treatment, date of the treatment, the date of re-treatment required, the name of the chemical and method used, the signature of an officer or approved representative of the Company providing flame proofing treatment, and the signature of an officer of the company installing the draperies. Official seal(s) and signature(s) of a notary public is required for the both signatures.
3. Labels clearly indicating date of manufacture, cloth type, manufacturer's name and address, size (width and height using 3/4" minimum lettering), and Owner's designated inventory number (to be coordinated with Owner) will be sewn into the back (in most cases, upstage) side of the upper hem at both ends of each drape panel.

1.4 QUALITY ASSURANCE

- A. Stage Curtain Installer's Qualifications: Firm experienced in the provision of systems similar in complexity to those required for this project; and meet the following:
1. No less than five years experience with equipment and systems of the specified types under the same business name.
 2. Experience with at least five comparable scale projects within the last two years.
 3. Employ only fully trained stage riggers and mechanics for the erection of the stage equipment.
 4. Installers will be completely familiar with the type of equipment to be installed. A competent and knowledgeable Job Superintendent will be on the job at all times when work is in progress.
 5. Stage rigging work shall be directly supervised by at least (1) ETCP certified rigger at all times.
 6. Maintain a fully staffed and equipped service facility.
 7. Contractor shall attend all pre-installation and coordination meetings on-site as requested by the Design Team, Owner and/or as required for the project.

1.5 PRE-INSTALLATION SUBMITTALS

- A. The submittal information required by the specification is to be presented complete and as submissions noted below. Submittals are a crucial and integral part of the construction process; as such, payment will not be made to the installer above 25% of the scheduled value of this work until all submittal information has been approved. Cost for Architect or Architect's consultant to review secondary and re-submittals due to the Installer's failure to include all required submittal information, or rejection of incomplete or improperly prepared submittal information will be the responsibility of the Installer. The cost shall be based on the hourly rates of the Architect and Architect's consultant as published in their current professional fees schedules and shall also include reimbursable costs for delivery, mailing, and photocopies at direct cost plus ten percent (10%).
- B. Project Submittal Part 1:
1. Provide for approval not later than thirty (30) days after issuance of Notice to Proceed and prior to commencement of Work:
 - a. Section 1: A complete schedule of submittals.

- b. Section 2: A chronological schedule of Work in bar chart form. Revise and resubmit schedule as required to reflect construction progress.

C. Project Submittal Part 2:

- 1. Provide for approval no later than sixty (60) days after issuance of notice to proceed and in accordance with previously submitted submittal schedule.
 - a. Section 1: Complete list of product to be incorporated within the Work.
 - b. Section 2: Manufacturer's data sheets for each product. Provide original manufacturer's data sheets in order as they appear in the specification. These data sheets are submitted for each product in sufficient detail to facilitate proper evaluation to the products suitability for incorporation within the Work.
 - c. Section 3: Fabric Samples. Submit a sample book of each fabric specified, containing manufacturer's standard colors available in the quality of fabric specified for the Owner's selection and approval of color. More than one color may be selected. After selection, upon request, submit one square foot sample of each fabric in each color for final review.
 - d. Section 4: Submit Material Safety Data Sheets (MSDS) for each potentially hazardous material prior to use. Include information pertaining to the hazardous material with the MSDS.
- 2. Shop Drawings:
 - a. Provide computer software generated drawings using standard industry graphic standards. Hand or poorly drawn documents will not be accepted.
 - b. Drawings which reproduce the construction drawings in whole or in part are not acceptable.
 - c. Provide complete assembly details of curtains including stitching schematics, weights, attachment details, and fabric/drape schedule.
 - d. General Detail Drawings. Provide detail drawings depicting any unique installation methods specific to each product.
 - e. Any other pertinent data generated which is necessary to provide the Work.

1.6 PROJECT RECORD MANUAL

- A. Submit three bound original sets (this is a minimum of two for the Owner and one for the Architect; additional copies may be required by the project's general conditions) after substantial completion and prior to final inspection.
- B. The Project Record Manual shall be segregated into three separate bindings as follows:
 - 1. Operations Manual:
 - a. Product Data: Product actually incorporated within the Work:
 - 1) Manufacturer's data for each type of product conforming to the scheme above. The list shall include manufacturer's serial numbers.
 - 2) Owner/Instruction Manual for each product.
 - 3) For custom circuits or modifications, a description of the purpose, capabilities, and operation of each item.
 - 4) Manufacturer's wiring diagram for each type of product actually incorporated.
 - 5) Separately bound list by manufacturer and model or part number of all products incorporated within the Work arranged in alphanumeric order.
 - b. Record drawings: Final rendition of that specified depicting what is actually incorporated within the Work. Provide one (1) full size set and one (1) DVD containing all CAD generated drawings prepared in conjunction with this project.
 - c. Test Reports: Recorded findings of testing specification of this specification.

- d. System Operation and Instructions: Prepare a complete and typical procedure for the operation of the equipment as a system, organized by subsystem or activity.
 - 1) This procedure should describe the operation of all system capabilities.
 - 2) Assume the intended reader of the manual to be technically experienced but unfamiliar with the components and the facility.
 2. Service & Maintenance Manual:
 - a. Provide an original copy of the service manual on every piece of equipment for which the manufacturer offers a service manual. Arrange manuals in the same order as the operations manual.
 - b. Manufacturer's maintenance and care instructions.
 - c. Maintenance Instructions, including maintenance phone number(s) and hours; maintenance schedule; description of products recommended or provided for maintenance purposes, and instructions for the proper use of these products.
 - d. Replacement parts list of all minor equipment such as fuses, lamps, connectors, knobs, etc.
 3. Warranty Manual:
 - a. Manufacturer's warranty statements on each product.
 - b. Date of substantial completion and ending dates for warranties for each group of products.
 - c. Software registration and licenses.
 4. Curtain Flame Proofing Documentation:
 - a. Provide all certificates, test reports, and documentation required for curtain flame proofing.
- C. Include any other pertinent data generated during the Project or required for future service.
- D. Appropriately duplicate data within the separate bindings when it will reasonably clarify procedures, e.g., operational data in maintenance binding.
- 1.7 DELIVERY, STORAGE, AND HANDLING
- A. Ship product in its original container, to prevent damaging or entrance of foreign matter.
 - B. Handling and shipping in accordance with manufacturer's recommendation.
 - C. Provide protective covering during construction, to prevent damaging or entrance of foreign matter.
 - D. Replace at no expense to Owner, product damaged during storage, handling or the course of construction.
- 1.8 PROJECT CONDITIONS
- A. Verify conditions on the job site applicable to this work. Notify Architect in writing of discrepancies, conflicts, or omissions promptly upon discovery.
 - B. The Drawings diagrammatically show arrangements of equipment fitting the space available without interference. If conditions exist which make it impossible to install work as shown, recommend solutions and/or submit drawings to the Architect for approval, showing how the work may be installed.

1.9 FINAL INSPECTION AND TESTING

- A. Upon completion of installation, initial adjustments, tests and measurements specified in Part 3, and submission and review of the results, a final inspection and test will be observed by the Architect and/or Architect's Consultant no earlier than two weeks after receipt of the written results.
- B. Provide a minimum of one (1) person for inspection and two (2) persons for testing familiar with aspects of the System to assist the Owner.
- C. The process of testing the System may necessitate moving and adjusting certain components such as drapery tracks.
- D. Testing includes operation of each major system and any other components deemed necessary. Perform tests and provide required test equipment, tools and material required to make any necessary repairs, corrections, or adjustments.
- E. The following procedures will be performed on each System:
 - 1. Inspection of the methods and means employed to incorporate the System within the facility.
 - 2. Verification of proper operation.
 - 3. Verification of proper adjustment, balance, and alignment of equipment for optimum quality and to meet the manufacturer's published specifications. Establish and mark normal settings for each setting, and appropriately record these settings within the Record Documents.
 - 4. Other tests on equipment or systems deemed appropriate.
- F. In the event the need for further adjustment or work becomes evident during testing, the Installer is to continue his work until the System is acceptable at no addition to the contract price. If approval is delayed because of defective equipment, or failure of equipment or installation to meet the requirements of these specifications and any extension of the inspection and testing period is required, the contract price will be reduced for the additional time and expenses of the Owner, at the standard rate in effect at that time.
- G. Installer shall return to the jobsite six months after acceptance to
 - 1. Inspect curtains and attachments
 - 2. Re-trim all curtains.

1.10 WARRANTY

- A. Warrant labor and product for two (2) years following the date of substantial completion to be free of defects and deficiencies, and to conform to the drawings and specifications as to kind, quality, function, and characteristics. Repair or replace defects occurring in labor or product within the Warranty period without charge. Any cost required to complete this warranty repair is the responsibility of the contractor.
- B. This warranty is in addition to any specific warranties issued by manufacturers for greater periods of time.
- C. Within the warranty period, answer service calls within eight hours, and correct the deficiency within twenty-four hours.

1.11 INSTRUCTION OF OWNER PERSONNEL

- A. After final completion, provide instruction to Owner and/or the Owner's designated personnel on the maintenance and care of the Stage Drapery.
 - 1. Develop training course based on the use of the System and manufacturers' recommendation. Provide one (1) hour of training. All training shall be scheduled at the convenience of the owner and designated personnel.
 - 2. Submit an outline of the course with sample instructional aids for approval thirty days prior to scheduled instruction sessions.
- B. If a representative of the manufacturer is used in the instructional course, the Installer must be present throughout the extent of the course and ensure that the representative abides by the requirements set forth in these specifications.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Model name and number for manufacturers included in this specification are listed to establish a standard of product quality.
- B. Substitution of specified products with other qualified manufacturers and products will be considered providing:
 - 1. Proper substitution procedures outline under Division 1 is adhered to.
 - 2. A request for substitution of each specific product must be made in writing by a bidding Contractor not less than ten (10) business days prior to bid for written approval of the Architect.
 - 3. Sufficient data of the products is presented for prior approval including technical data, manufacturer's specifications, samples, and, if requested, results of independent testing laboratory tests.
 - 4. Written permission is obtained for the substitution from the Owner or Owner's Representative.
- C. If proposed system includes equipment other than specified model numbers, submit a list of major items and their quantities, with a one-line schematic diagram for review. Include a list of previously installed projects using proposed equipment that are similar in nature to specified System.
- D. Provide product not specifically specified commensurate with the quality and standards established by the specified product.

2.2 GENERAL

- A. Products shall be new, free from defects and listed by UL when an applicable UL Standard exists. Provide product of a given type from one manufacturer.
- B. Regardless of the length or completeness of the descriptive paragraph herein, provide product complying with the specified manufacturers' published specifications.

2.3 PRODUCTS

A. Perimeter Curtains:

1. Supplier: KM Mills, Greenville, South Carolina.
2. Fabric: 20 oz synthetic IFR Crescent velour (54 inch width).
 - a. Color: Black.
3. Size: Quantity of 14 foot wide panels as required to encircle the room.
4. Panel Width: 5 full widths per panel.
5. Installation: On perimeter track.

B. Sky Cyclorama Curtans:

1. Supplier: Rosebrand Fabric, New York City, New York.
2. Fabric: Seamless white muslim, chemically flameproof (20'-4" width).
 - a. Color: Bleached white.
3. Size: Width to cover two side walls.
4. Width: 1 seamelss width.
5. Installation: On perimeter track.

C. Curtain Traveler Tracks:

1. Manufacturer: H&H Specialties, South El Monte, California.
2. Two 360 degree runs of H&H #301 walk-along track complete with all necessary accessories including #301 carriers with trim chain and mounting brackets to rigidly mount track to pipe grid. Outside track shall be 12 inches off side wall and inside shall be 9 inches clear from outside track.

2.4 STAGE CURTAINS - BLACK BOX

A. General Specification for Stage Curtains

1. Provide and install all curtains as located and scheduled on the drawings.
2. Field verify all dimensions prior to fabrication of curtains.
3. Curtain fabric of professional grade fabric intended for stage use. If not inherently flame retardant, curtain fabric shall be chemically flame proofed at the mill using an immersion process. Flame proofing certificates for all fabrics used shall be furnished to the owner with the as-built drawings.
4. Sew tags identifying manufacturer and size of panel at each end of webbing at top and at one corner at hem in each curtain
5. Curtains must be constructed with vertical seams unless otherwise specified. The fabric grain shall run nap down and match in all panels. All panels must be unspliced along their height.
6. Use mercerized cotton thread, minimum weight of #16, color to match drape fabric.
7. Sew a 12" x 12" swatch of fabric near the lower offstage corner of each curtain for fire-residence testing by the AHJ.
8. Fabric colors shall be as indicated. Submit color sample card with submittal documents. Make all effort to ensure that curtains of the same color are fabricated from fabrics of the same dye lot
9. Labeling
 - a. Sew labels onto the back side of the upper hem at both ends of each panel.
 - b. Labels shall clearly indicate
 - 1) date of manufacture
 - 2) cloth type
 - 3) manufacturer's name and address

- 4) size (width and height using 3/4" minimum lettering)
- 5) owner's designated inventory number

B. Construction of Perimeter Curtains:

1. Polyester webbing at 3-1/2 " wide shall be double stitched to the top of the curtain with 1" of face fabric turned under the webbing.
2. Brass rustproof grommets shall be inserted
 - a. at the extreme top corners
 - b. in the pleat centers of curtains sewn with fullness, or
 - c. on 12" centers for flat curtains.
3. Grommet holes for track mounted curtains shall be supplied with
 - a. plated wire "S" hooks, or
 - b. snap hooks, sewn-in at the spacing noted above.
4. Spare and loose curtains and drapery hung directly from an auxiliary batten shall have a 24" long black cotton tie line fastened in each grommet hole.
5. The centerline of the curtain shall be marked on the top webbing with "CL" and a white tie line added to the corresponding grommet.
6. Curtains sewn with fullness shall have box pleats spaced 12" on center.
7. Bottom hems shall be 4" wide. These shall be sewn with a separate canvas chain pocket inside so that the bottom of the canvas pocket rides 2 inches above bottom of the hem. Provide #8 plated jack chain in the pocket.
8. Unless scheduled otherwise, all legs and travelling curtains shall be sewn with a minimum 12" of face fabric turned back at the leading edge. All other vertical hems shall be 4".

C. Construction of Sky Cyclorama Curtain:

1. Across the top of each unit the fabric shall sewn flat to a 3-1/2" webbing double stitched with #16 mercerize cotton thread.
2. Provide 2" plated harness snap hook at 12" on center across webbing. In each snap hook shall be attached as described above.
3. Sew a 6" bottom hem. In the bottom hem, sew in a canvas pipe pocket large enough to accommodate a 1" pipe and provide chain in bottom pocket. Provide bottom 3/4" rigid conduit in 10' sections with threaded couplings for joints.
4. Side hems shall be 3" wide double folded double stitched hems.

2.5 HANGING PIPE GRID SYSTEM

A. Provide stationary pipe grid which extends to the perimeter walls and as shown on the drawings:

1. Pipe grid spacing is to be 4'-0" by 4'-0" on center and installed 15'-0" off the finished floor.
2. Grid pipe is to be 1-1/2" schedule 40 pipes painted black. Where splices are required, provide sleeve of the same diameter as the inside of the pipe, minimum 18" long. The sleeve will be held in place by four (4) bolts.
3. Hanger spacing will not exceed 8'-0" and each pipe will be supported by a hanger at least 2'-0" from the end of each pipe. Each hanger will be constructed from 3/16" proof coil chains.
4. Grid brackets will be required at each joint where the sections of 1-1/2" pipe cross around the perimeter of the grid and at every other junction on the interior. Brackets are to be #308 1-1/2' by 1-1/2" grid brackets or Roto Lock by Upright Scaffolding.

5. The entire grid will be attached to the vertical sidewalls in at four equal points on each side of the grid by extending the pipe to the sidewall and attaching it to a wall flange. The mounting shall be rigid and in such a way as to secure the entire grid from movement.

2.6 COMPLETED SYSTEM

A. General

1. All installation of stage rigging equipment shall be completed utilizing new materials, free from flaws and rust, and in good working order. The jobsite shall be cleaned of all packing materials, lubricants, metal shaving, miscellaneous hardware, and components not used in the installation.
2. All dimensions are to be field verified. Location and attachment of hardware and size of components shall be confirmed by the stage rigging installer.
3. All electrical power, outlets, related systems, and structural elements required to make the system fully functional are the responsibility of the contractor.

B. Trimming/Leveling of Stage Curtains:

1. Contractor is to return to the jobsite within sixty (60) days, but not less than thirty (30) days of the installation to re-trim all tracks and curtains.
2. Provide documented notes on site visit to Architect and Architect's Consultant on adjustments made during return visit

PART 3 - EXECUTION

3.1 GENERAL

- A. Coordinate incorporation of the Work specified herein with other project work so as to facilitate a cohesive final product.
- B. Mount equipment and enclosures plumb and level.
- C. Permanently installed equipment to be firmly and safely held in place in accordance with specified safety factors and Federal and State codes and regulations.
- D. Work shall be completed within industry guidelines, including, Entertainment Services and Technology Association (ESTA), OSHA, American National Standards Institute, American Society for Testing and Materials, American Institute of Steel Construction, National Fire Protection Association, plus any or all local, governmental, or other applicable codes.
- E. Where dimensions and loading capacities have been omitted from this specification, they are to be determined by the theatre rigging contractor, in accordance with the accepted industry standards and guidelines in this section. In no way will the theatre rigging contractor be relieved of primary responsibility to provide a safe, fully functional system.
- F. The mechanical fabrication and workmanship will incorporate the best practices for good fit and finish. There will not be any burrs or sharp edges to cause a hazard, nor will any sharp corners accessible to personnel.
- G. All equipment will be installed based on the manufacturer's recommendations and for the use intended by the manufacturer.

- H. All shop and field welding will meet the qualifications of the AISC manual and will be without spatter or other evidence of poor practices.
- I. All finishes which are disturbed during shipping and installation will be touched up to match the original.

3.2 INSTALLATION OF STAGE CURTAINS AND TRACKS

- A. Install all track mounted curtains to hardware according to track manufacturer's recommendations.
- B. Stage curtains shall be installed near the end of the installation when chances of damage from other work are reduced. Stage area shall be broom clean with no further construction taking place prior to installation.
- C. After hanging stage curtains, thoroughly brush to remove dust, visible dirt, loose threads, loose fabric lint, etc. Wrinkles will be allowed to fall out naturally.
- D. Verify that each curtain panel bears a label as described in paragraph 2.4., A, 9 above.

END OF SECTION

SECTION 11 61 00 - THEATRICAL LIGHTING SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Construction Contract, including General Conditions and Division 1 Specification Sections, apply to this Section.
- B. TL series Drawings.

1.2 REFERENCES

- A. National Fire Protection Association (NFPA)
- B. National Electrical Code (NEC)
- C. American National Safety Institute (ANSI)
- D. Entertainment Services and Technology Association (ESTA)
- E. National Electrical Manufacturers Association (NEMA).
- F. TX State and City of Houston Building Code.

1.3 RESPONSIBILITY AND RELATED WORK

- A. The written specification and TL series drawings shall be collectively referred to herein as the Contract Documents.
- B. Contractor shall provide, based on the Contract Documents, a complete, turnkey system, tested and ready for acceptance testing. The Contract Documents are developed to the extent required to properly convey design intent and system infrastructure. It is understood by the contractor that they are to supply additional equipment, as required, to provide a complete and working system.
- C. System features or devices which are mentioned in one part of the Contract Documents may not be shown in the other. In case of conflict between the written specifications and the drawings, Contractor must seek clarification from the Consultant. If the Contractor fails to obtain such clarification, the interpretation of the Consultant will prevail.
- D. Contractor shall obtain all licenses and permits necessary for the execution of any work pertaining to the installation within this scope of work.
- E. Refer to TL0.00 for division of responsibilities related to the theatrical lighting system.

1.4 DEFINITION OF TERMS & ABBREVIATIONS:

- A. Provide: to supply and install.
- B. Furnish: to supply to another contractor for installation.
- C. Supply: to supply but not install.
- D. Install: to install but not supply.
- E. OFE: Owner furnished (supplied) equipment. Equipment will be provided to contractor for installation.
- F. NIC: Not In Contract. Refers to items that are not included in the scope of work outlined in this section but may be shown for coordination purposes or reference.
- G. Future: Equipment that will be provided by owner later. Accommodations shall be provided for future equipment as shown on the drawings.

1.5 SYSTEM DESCRIPTION

- A. The theatrical lighting system will use LED-based lighting fixtures where to reduce the operating cost and maintenance effort required to keep the system running.
- B. LIGHTING POWER AND CONTROLS

1. Fixtures with integrated dimming capabilities will be used. No dimmer rack or portable dimmer packs will be provided. Non-dimmed power circuits will be distributed to the lighting positions that will accommodate these fixtures (LED or automated lights) as well as providing the opportunity for temporary portable dimmer packs to be used with conventional light fixtures if desired.
 2. Controls for the theatrical lighting system will include:
 - a. A lighting control console with at least 2 DMX Universes (expandable to at least 4), sACN (lighting) network connectivity, and the ability to support a minimum of 1 touch screen monitors.
 - b. A stage manager's panel, with a touchscreen that can control basic theatrical lighting presets.
- C. LIGHTING INSTRUMENTS
1. The lighting instrument package will include:
 - a. LED Ellipsoidals (beam angles TBD)
 - b. LED PARs
- D. LOOSE EQUIPMENT
1. The loose equipment package will consist of:
 - a. DMX cables
 - b. Cat5e Ethernet cables with Ethercon connectors
 - c. 20A Powercon extension cables
 - d. Powercon to SPG adapters
- 1.6 PRE-BID SUBMITTALS
- A. Comply with all requirements of Division 1.
 - B. Bid Clarifications. Contractor is responsible for reading and understanding all information presented in these specifications and related documents outlined in Section 1. Discrepancies between drawings and specifications or other errors or omissions should be brought to the Consultant's attention a minimum of 5 days prior to bid date. Failure to do so does not relieve the contractor from the requirement to provide a fully operational and turnkey system. In this event, the Contractor agrees to abide by the decision of the Consultant for resolution.
 - C. Contractor Qualifications. Contractors will be considered by the Owner and Consultant upon receipt of qualifications as outlined in Bid Submittals section below.
- 1.7 BID SUBMITTALS
- A. Comply with all requirements of Division 1.
 - B. Submit according to conditions of the Construction Contract and Project Manual.
 - C. Bidders that have not been pre-qualified shall submit the following information:
 1. Company profile including history, number of employees, facility size and completed projects.
 2. Installer shall have previously installed at least three jobs of similar magnitude, completed within the last five years. A resume shall be provided for these projects including project name, scope of services, year completed, and contact information for a reference. Provide at least one such completed job for inspection by the Architect and/or consultant.
 3. Installer shall have five years of experience with equipment and systems of the types specified, shall maintain a fully staffed and equipped service facility, and shall be a franchised dealer and authorized service facility for the major brands specified, and shall be properly licensed to work in Houston, TX
 4. Resume of key personnel to be used on this project, including but not limited to: Project Manager; Lead Engineer; Job-Site Superintendent.
 5. A sample set of shop drawings or as-built documents that confirm the Contractor's capabilities to provide engineering and documentation for the project.
 6. A line sheet listing all manufacturers the Contractor is a dealer and/or authorized service center for.
 7. A description of the Contractor's abilities for in-shop assembly, fabrication, and testing.

- D. The Bidder shall disclose in the bid whether any portions of the project work will be subcontracted out. All terms of this contract, including bidding and qualification statements, shall apply to the subcontractor. Provide the following information for each subcontractor to be used:
 - 1. Name of the proposed subcontractor.
 - 2. A statement of qualifications for each subcontractor.
 - 3. A scope of work outlining what portions of the project for which the subcontractor will be responsible.
- E. Include the following information with the bid submittal:
 - 1. The total contract price.
 - 2. The total price for any add or deduct alternates.
 - 3. The price for contractor tests and adjustments as outlined in Section 3.3.
 - 4. An itemized equipment list.
 - 5. Unit pricing for all equipment listed above.
 - 6. A breakdown of the number of labor hours for each of the following:
 - a. Engineering and documentation.
 - b. On site coordination meetings and supervision.
 - c. In shop fabrication and assembly.
 - d. On site fabrication, assembly, and installation.
 - e. On site verification and testing.
- F. Substitutions. Contractor shall note all substitutions at the time of bid. Any proposed substitutions must meet all specifications of the specified equipment. No product substitution will be accepted without the written approval of the Consultant or Owner. Consultant and owner retain the right to reject any proposed substitution.
- G. Contractor to obtain all licenses and permits necessary for the execution of any work pertaining to the installation, or any operation by the Owner.

1.8 PROJECT SUBMITTALS

- A. Comply with all requirements of Division 1.
- B. Submit according to conditions of the Construction Contract and Project Manual.
- C. Make each specified submittal as a coordinated package complete with all information. Uncoordinated sets will be returned without review.
- D. Product Data: Submit within 30 days of contract award. Submit manufacturer's product data sheets for each item of equipment that will be provided as part of this contract. Submit electronically as a single PDF. All equipment cut sheets will be arranged per specification section number. Provide a table of contents and a bookmark at the start of every product sheet.
- E. Shop Drawings
 - 1. Submit within 60 days of contract award.
 - a. Failure to submit shop drawings with ample time for evaluation shall not entitle the contractor to an extension of contract time.
 - b. There will be no work authorized on site without the prior submittal (and subsequent approval) of a complete set of shop drawings. Any exceptions to this must be in writing and approved by the Consultant.
 - c. Review of shop drawings is for general conformance with the design intent and general compliance with the contract documents of the project. Corrections, comments or markings made do not relieve the Contractor from compliance with the Contract Documents nor allow departure there from. Contractor remains responsible for detailing and accuracy, confirming and correlating quantities and dimensions, selecting fabrication processing and techniques of construction, coordinating work with that of other trades, and performing work in a safe a satisfactory manner.
 - 2. Submitted as a multi-sheet PDF document with:
 - a. Minimum 11" x 17" sheets
 - b. Table of Contents.
 - c. Bookmarks for every sheet with Sheet Name and Number

3. Drawings shall be a standalone package containing all information required for system installation. The package shall include:
 - a. A legend of all symbols and abbreviations used in the drawing package
 - b. Plan View Drawings showing:
 - 1) Locations of all equipment and devices
 - 2) Locations of junction boxes, with associated conduits and cable fill
 - 3) Coordinated layouts of:
 - a) Equipment Rooms
 - b) Control Booths
 - c) Follow Spot Booths
 4. Section and Elevation Drawings including but not limited to:
 - a. Lighting fixture hang positions
 5. Equipment Rack Elevations including:
 - a. Location of all equipment within the rack
 - b. Heat loads for each equipment rack and calculations showing how numbers were derived
 6. AC Power Requirements
 - a. For each equipment rack show:
 - 1) Power requirements and calculations showing how numbers were derived
 - 2) Power distribution details within each rack
 7. Rigging Detail Drawings
 - a. Details will be submitted with licensed engineer stamp licensed in the state in which the project resides.
 - b. Drawings will include:
 - 1) Structural attachment details
 - 2) Welding calculations
 - 3) Types of hardware to be used
 8. Wiring Schematics
 - a. Complete and detailed wiring schematic for all systems including:
 - 1) Cable types
 - 2) Identification by number and color codes
 - 3) Detailed wiring of connections to equipment and between equipment racks
 9. Schematic drawings of any custom circuitry or equipment modifications, including connector pin-outs and component lists.
- F. Schedules showing:
1. Cable Types
 - a. Type Identifier matching Contract Documents
 - b. Manufacturer
 - c. Part Number
 - d. Signal Group
 - e. Nominal Outside Diameter
 2. Junction Boxes
 - a. Box Name
 - b. Drawing Reference
 - c. Location
 - d. Dimensions
 - e. Mounting Height
 3. Pull Schedule
 - a. Pull Length
 - b. Source and Destination
 - c. Wire Number
 4. Custom Color and Finishes for:
 - a. Fixtures
 - b. Custom Panels
 - c. Exposed Cabling
 5. Conduit riser diagram showing interconnect of all systems

6. Terminal strip layouts for all terminal strips to be used in junction boxes or equipment racks
 7. Connector wiring details including connector model numbers
 8. Network schematic showing:
 - a. Logical Connections of all devices
 - b. IP address scheme
 - c. VLAN Scheme
 9. Custom Panel Details including:
 - a. Materials
 - b. Finishes
 - c. Dimensions
 - d. Connector Layout
 - e. Connector Labeling
 10. Lighting patch bay layouts and labeling scheme
 11. Mounting and orientation details for:
 - a. Access points
 - b. Wireless antenna
 12. Relay panel physical and electrical details
 13. Control systems physical and electrical details
 14. Distribution devices physical and electrical details
- G. Final Inspection Notification Report- Two copies of a computer-generated checkout report for the entire system will be prepared and submitted two weeks prior to system commissioning. It will include:
1. A complete listing of every piece of equipment including serial number, the date it was tested and by whom, the results and (if failure occurred during any previous tests) the date retested
 2. The final report will indicate that every device tested successfully.
 3. A performance test report indicating that the system meets all of the Contractor testing requirements in Section 3.3 and 3.5.
 4. A copy of the Final Inspection Report shall be included in the Project Manual.

1.9 CONTRACT CLOSEOUT SUBMITTALS

- A. Comply with all requirements of Division 1.
 1. Submit all contract closeout documentation within 30 days after substantial completion, unless otherwise noted. Documents should be contained on a single USB Drive.
- B. Contractor shall work from approved shop drawings only. Note changes made during installation on a single set of drawings. This set of marked up drawings will not leave the jobsite until after the final system commissioning. Submit one corrected set of reproducible drawings showing work as installed. All "as-built" drawings to be provided in electronic form (ACAD 2010 or later and PDF).
- C. Contractor to provide a Project Manual prior to acceptance testing. Provide one electronic copy (PDF). This manual shall contain the following information:
 1. Table of Contents.
 2. A legend of acronyms and abbreviations must accompany all documentation.
 3. Contractor's contact information for warranty and or service.
 4. A complete list of equipment, both installed and loose gear. Include manufacturer, model number, and serial number for all devices. Include settings (software or hardware settings) for any devices that required modification or adjustment during the acceptance testing.
 5. Operating manuals for each device.
 6. Service manuals for each device.
 7. Documentation of all testing results as outlined in Section 3.3 and 3.5
 8. Replacement parts lists of major items of equipment.
 9. Suggested schedule of routine maintenance. Schedule should include dates such as of replacement of all batteries, cleaning of air filters etc.

10. System Operation and Instructions- Prepare a complete and typical procedure for the operation of the equipment as a system, organized by subsystem or activity. This procedure should describe the operation of all system capabilities. Assume the intended reader of the manual to be unfamiliar with both the equipment and this facility.
 11. A list of all equipment, indicating manufacturer, model, serial number, and equipment location (i.e. panel/rack/room number). Update following acceptance testing, if changed.
 12. As-Built drawings to include the following:
 - a. Updated lighting hang plot with circuit numbering and control addressing.
 - b. Lighting distribution plot.
 - c. Updated instrument schedule and hook up sheets.
 - D. Software Licensing and Manuals. Provide backup computer discs, all software manuals and license certificates for all software loaded on all PC's. Include all original software installed, or downloaded, to devices in the system as part of the USB Drive.
 - E. Asbestos and PCB Certification: After completion of installation, but prior to Substantial Completion, Contractor will certify in writing that products and materials installed, and processes used, do not contain asbestos or polychlorinated biphenyls (PCB).
- 1.10 DELIVERY, HANDLING, STORAGE
- A. Comply with Division 1 General Conditions.
- 1.11 CODE COMPLIANCE
- A. All work and materials shall comply with all applicable codes and regulations to meet or exceed Federal, State, City, and Local Building Codes and Regulations. Advise the Architect if anything in the Plans or Specifications is out of compliance with codes and/or laws prior to bidding.
- 1.12 PROJECT CONDITIONS
- A. Verify conditions on the job site applicable to this work. Notify the General Contractor in writing of discrepancies, conflicts, or omissions promptly upon discovery.
 - B. The drawings diagrammatically show cabling, conduit, wiring, and arrangements of equipment fitting the space available without interference. If conditions exist which make it impossible to install work as shown, recommend solutions and/or submit drawings to the Consultant for approval, showing how the work may be installed.
- 1.13 WARRANTY
- A. Installer shall warrant equipment to be free of defects in materials and workmanship for not less than one year after date of Substantial Completion. Defects occurring in labor or materials within one-year warranty shall be rectified by replacement or repair. Within the warranty period, provide answer to service calls and requests for information within a 24-hour period, and repair or replace any faulty item within a 72-hour period without charge, including parts and labor.
 - B. This warranty shall not include any consumable items (eg. patterns).
 - C. This warranty shall not void specific warranties issued by manufacturers for greater periods of time. Nor shall it void any rights guaranteed to the Owner by law.
 - D. Theatrical Lighting Contractor to provide Owner with exact beginning and ending dates of the warranty period. Include the name of the person to call for service and telephone number. This information to be part of Project Record Drawings.

PART 2 - PRODUCTS

2.1 UNAUTHORISED MATERIALS

- A. Materials and products required for work of this section shall not contain asbestos, polychlorinated biphenyls (PCB) or other hazardous materials identified by the General Contractor or Owner.

- B. All devices shall have applicable approvals from a Nationally Recognized Testing Laboratory and meet all applicable local codes and requirements. Should any equipment lack proper approval the Contractor will arrange for onsite inspections and certification at no additional expense to the Owner.

2.2 ACCEPTABLE MANUFACTURERS

- A. Model numbers and manufacturers included in this specification are listed as a standard of quality.
- B. Consultant will consider other qualified manufacturers subject to review. Submit according to conditions of the Construction Contract and Project Manual.
- C. Proposed substitutions must meet all specifications of the specified equipment. The Contractor will supply complete technical data specifications at the time of proposed substitution.
- D. The Contractor will arrange for product demo at the request of the Consultant or Owner Representative and will pay ground freight shipping to and from site, or to and from Consultant's office.
- E. No product substitution will be accepted without the written approval of the Consultant and Owner. The Owner, General Contractor, and the Consultant reserve the right to accept or refuse any substitution without condition.
- F. Upon acceptance of a substitution, Contractor assumes all responsibility for verification and coordination of all heat, power, rack space and architectural requirements.
- G. If product is discontinued and/or no longer publicly advertised as a part of a manufacturer's current product line-up at time of installation, the project team reserves the right to request a substitution of product for new and currently offered product of like function fulfilling the design intent. Substitution value will be based on fair market value of original product at time of bid.

2.3 GENERAL

- A. Equipment and materials shall be new, meet the latest published specifications of that product, and conform to applicable regulatory provisions. Take care during installation to prevent scratches, dents, chips, etc.
- B. Theatrical Lighting Contractor shall verify all site conditions prior to fabrication and installation of all equipment. Notify Consultant of any discrepancies in site conditions or design documents as soon as identified.
- C. Wiring of power distribution cable shall be in accordance with the electrical engineer's specification.
- D. Wiring of control distribution cable shall be in accordance with the manufacturer's specification.
- E. Installation of theatrical lighting support pipes shall be in accordance with the structural engineer's specification.
- F. All products and materials to be handled and shipped in accordance with manufacturer's recommendation.
- G. Provide protective covering on equipment and furniture during construction to prevent damage or entrance of foreign matter.
- H. Replace at no expense to Owner, product damaged during delivery, storage, handling or construction.

2.4 RIDGE HS AUDITORIUM - THEATRICAL LIGHTING SYSTEM

- A. Lighting Control Console (Quantity: 1)
 - 1. ETC Ion Xe 20 with 12,288 outputs
 - 2. Provide two (2) 27" Touchscreen Monitor with Black Bezel and minimum 1920 x 1080 resolution.
 - 3. Provide one (1) appropriately sized Desktop UPS device (No cooling fans).
 - 4. Provide one (1) 15' Cat 5e Network Patch Cable
- B. DMX Rack Mount 4-Port Node (Quantity: 6)

1. ETC Response Mk2 4-Port-Terminal
 2. Provide with Gateway Rack Mount Kit.
 3. Provide with all necessary patch cables to interface with lighting network.
 4. Units shall be mounted in racks A.LER.01 and A.LER.02.
- C. DMX Portable Two Port Node (Quantity:6)
1. ETC Response Mk2 RSN-DMX2-0-P
 2. Provide node mounted in back box with clamp for portable hanging.
 3. Provide node with 7.5 foot Network patch cable.
 4. Portable node shall be powered via Ethernet.
 5. Color to be Black.
- D. Network Patch Panel (Quantity: 4)
1. Provide Bittree or approved equivalent.
 2. Provide appropriately sized network patch panel.
 3. Provide as standard rack mountable unit.
 4. Patch panels shall be located in racks A.LER.01 and A.LER.02.
- E. Single Space Brush Panel (Quantity: 6)
1. Provide Middle Atlantic BR1 or approved equivalent.
- F. Network POE Switch (Quantity: 2)
1. CISCO CBS350-24P or approved equivalent
 2. Provide as standard rack mountable unit.
 3. Switches shall be located in racks A.LER.01 and A.LER.02.
- G. Wall Mounted Network Switch (Quantity: 1)
1. ETC Simple Network Box SNB8FP or approved equivalent.
 2. Box is labelled as A.LER.03.
- H. Lighting Console Interface Panel NET/NET/NET (Quantity: 2)
1. ETC or approved equivalent.
 2. Panel labeled as A.LWP.01 & 02.
 3. Provide these as flush wall plates w/Ethercon receptacles mountable in existing backboxes.
- I. NET Plug In Ethercon Panel (Quantity: 7)
1. ETC or approved equivalent.
 2. Provide this as a flush wall plate w/Ethercon receptacle mountable in either existing or new backbox locations.
 3. Panels labelled as A.LWP.03 thru 06 and A.LPB.01 thru 03.
- J. NET Plug In Pipe Mount Ethercon Box (Quantity: 4)
1. ETC or approved equivalent.
 2. Provide this as single receptacle u-bolt pipe mount box w/Ethercon receptacle.
 3. Panels labelled as A.LPB.04 thru 07.
- K. Dimmer Rack Renovation (Quantity: 3)
1. Provide ETC Sensor SR48 Rack Power Package upgrade w/5 year warranty.
- L. Theatrical Lighting DMX/NET Relay Rack, 24 space (Quantity: 1)
1. ETC ECHO Pass through ze
 2. Provide with twenty-four (24) 20A single pole relays.
- M. Ellipsoidal Theatrical Lighting Instrument (Quantity: 66)
1. ETC ColorSource Spot V w/shutter assembly or approved equivalent.
 - a. 19° - 28
 - b. 26° - 14
 - c. 36° - 20
 - d. 50° - 4
 2. Provide complete with c-clamp, gel frame, safety cable and 3' lead terminated to a NEMA 5-15P.
 3. Refer to Theatrical Lighting Plan for hang and focus details.
- N. Fresnel Theatrical Lighting Instrument (Quantity: 27)

1. ETC ColorSource Fresnel V or approved equivalent.
 2. Provide complete with c-clamp, gel frame, safety cable and 3' lead terminated to a NEMA 5-15P.
 3. Refer to Theatrical Lighting Plan for hang and focus details.
- O. Cyc Theatrical Lighting Instrument (Quantity: 18)
1. ETC ColorSource Cyc or approved equivalent.
 2. Provide complete with c-clamp, gel frame, safety cable and 3' lead terminated to a NEMA 5-15P.
 3. Refer to Theatrical Lighting Plan for hang and focus details.
- P. PARnel Theatrical Lighting Instrument (Quantity: 22)
1. ETC Source4WRD II retrofit kit and Source4WRD PARnel fixture body or approved equivalent.
 2. Provide complete with c-clamp, gel frame, safety cable and 3' lead terminated to a NEMA 5-15P.
 3. Refer to Theatrical Lighting Plan for hang and focus details.
- Q. Linear Theatrical Lighting Instrument (Quantity: 5)
1. ETC ColorSource Linear 2 or approved equivalent.
 2. Provide complete with c-clamp, floor trunion, gel frame, safety cable and 3' lead terminated to a NEMA 5-15P.
 3. Refer to Theatrical Lighting Plan for hang and focus details.
- R. LED Followspot (Quantity: 2)
1. Canto Aurora X1 Short or approved equivalent.
 2. Provide complete with floor stand and 15' power cord terminated to a NEMA 5-15P.
- S. DMX Extension Cable (Quantity: 140)
1. 5' – 0
 2. 10' – 0
 3. 15' – 140
 4. 25' – 0
 5. Cables shall be labeled for length using appropriately sized self-adhesive numbers 3" from both connector ends covered by clear heat shrink tubing.
 6. Cables shall be supplied with one (1) appropriately sized Velcro cable tie.
 7. Cables shall be black.
 8. Cable shall be constructed according to USITT DMX512/1990 standard.
 9. Cables shall be constructed with one (1) 5 pin XLR Male connector and one (1) 5 pin XLR Female connector.
- T. 20A PowerCon TRUE1 Extension Cable (Quantity: 140)
1. 5' – 0
 2. 10' – 0
 3. 15' – 140
 4. 25' – 0
 5. Cables shall be labeled for length using appropriately sized self-adhesive numbers 3" from both connector ends covered by clear heat shrink tubing.
 6. Cables shall be supplied with one (1) appropriately sized Velcro cable tie.
 7. Cables shall be black.
 8. Cable shall be constructed using 12/3 SJOO-W cable.
 9. Cables shall be constructed with PowerCon TRUE1 connectors rated for 120vac @ 20amp loads.
- U. RJ45 to 5-Pin Female Connector (Quantity: 10)
- V. 3' Molded Cat6 Patch Cable (Quantity: 64)
- W. Color Media:
1. Provide a color media allowance for 12 – 20" x 24" sheets of R119.

2.5 RIDGE HS AUDITORIUM - ARCHITECTURAL LIGHTING CONTROL SYSTEM

- A. Architectural Control Rack (Quantity: 1)
 - 1. ETC Unison ERn2-RM
 - 2. Provide with one (1) P-ACP architectural control processor.
 - 3. Provide with one (1) P-SPM-E Station Power Module.
 - 4. Unit shall be mounted in rack A.LER.01.
- B. Architectural LCD Touchscreen Station (Quantity: 1)
 - 1. ETC Unison P-TS7-PE
 - 2. Provide with portable desktop stand 95622.
 - 3. Provide Station with 25' cable.
 - 4. Confirm color with architect.
- C. Architectural LCD Rack Mount Touchscreen Station (Quantity: 1)
 - 1. ETC Unison P-TS7-PE
 - 2. Provide with rack mount plate.
 - 3. Color to be black.
- D. Architectural Entry Station (Quantity: 6)
 - 1. ETC Unison UH10005-_1F.
 - 2. Confirm color with architect.
- E. Architectural Entry Station (Quantity: 2)
 - 1. ETC Unison UH10002-_1F
 - 2. Confirm color with architect.
- F. Architectural Entry Station (Quantity: 2)
 - 1. ETC Unison UH10002-_1F with custom coverplate for existing back boxes.
 - 2. Confirm color with architect.
- G. Architectural Entry Station (Quantity: 3)
 - 1. ETC Unison UH40604-_1P with custom coverplate for existing back boxes.
 - 2. Confirm color with architect.
- H. Emergency Bypass Detection Kit (Quantity: 1)
 - 1. ETC Emergency Bypass Detection Kit EBDK
- I. Emergency Bypass DMX Controller (Quantity: 1)
 - 1. ETC DMX Emergency Bypass Controller DEBC-6

2.6 RIDGE HS BLACK BOX – THEATRICAL LIGHTING SYSTEM

- A. Lighting Control Console (Quantity: 1)
 - 1. ETC Ion Xe 20 with 2,048 outputs
 - 2. Provide two (2) 27" Touchscreen Monitor with Black Bezel and minimum 1920 x 1080 resolution.
 - 3. Provide one (1) appropriately sized Desktop UPS device (No cooling fans).
 - 4. Provide one (1) 15' Cat 5e Network Patch Cable
- B. Equipment Racks Wall Mounted (Quantity: 1)
 - 1. MIDDLE ATLANTIC DWR series 22" Deep Racks
 - 2. Provide appropriately sized rack for equipment listed in this spec as being located within the rack.
 - 3. Provide rack with sufficient horizontal cable managers to separate all switches and patch bays with one cable manager each. PANDUIT WMPF1E or approved equivalent.
 - 4. Provide rack with appropriately sized blank filler panels to close all unused rack spaces.
 - 5. Provide rack with sufficient and appropriately sized hook and loop fastener cable ties to neatly dress all patch cables for the lighting network.
 - 6. Provide rack with appropriately sized rack mount UPS to power all equipment located in the rack.
 - 7. Rack is labelled as BB.LER.01
- C. DMX Rack Mount 4-Port Node (Quantity: 1)
 - 1. ETC Response Mk2 4-Port-Terminal

2. Provide with Gateway Rack Mount Kit.
 3. Provide with all necessary patch cables to interface with lighting network.
 4. Unit shall be mounted in rack BB.LER.01.
- D. Network Patch Panel (Quantity: 2)
1. Provide Bittree or approved equivalent.
 2. Provide appropriately sized network patch panel.
 3. Provide as standard rack mountable unit.
 4. Patch panels shall be located in racks BB.LER.01.
- E. Single Space Brush Panel (Quantity: 3)
1. Provide Middle Atlantic BR1 or approved equivalent.
- F. Network POE Switch (Quantity: 1)
1. CISCO CBS350-24P or approved equivalent
 2. Provide as standard rack mountable unit.
 3. Switch shall be located in rack BB.LER.01.
- G. DMX Two Port Node (Quantity:8)
1. ETC Response Mk2 RSN-DMX2-0-P or approved equivalent.
 2. Provide node mounted in back box with clamp for portable hanging.
 3. Provide node with 15' Network patch cable.
 4. Portable node shall be powered via Ethernet.
 5. Color to be black.
- H. Theatrical Lighting DMX/NET Relay Rack, 24 space (Quantity: 1)
1. ETC ECHO Pass through
 2. Provide with twenty-four (24) 20A single pole relays.
- I. Lighting Pipe Mount Box (Quantity: 30)
1. ETC 9800 Series with offset brackets or approved equivalent
 2. Pipe boxes of the following configurations:
 - a. BB.LPB.01, 03, 04, 06, 08, 11, 13, 15, 16, 18, 20, 23, 25, 27, 28 and 30:
 - 1) 1 - 120V util ckts to 1 – 5-20 flush duplex receptacle and 1 – Ethercon network control receptacle.
 - b. BB.LPB.02, 05, 07, 09, 10, 12, 14, 17, 19, 21, 22, 24, 26 and 29:
 - 1) 1 - 120V util ckt to 1 – 5-20 flush duplex receptacle.
 3. Pipe mount boxes shall be mounted to 1 ½" Schedule 40 pipe in locations as shown on the drawings.
 4. Pipe mount boxes shall include labeling indicating what source(s) they are fed from located on the faceplate of the box. It is the responsibility of the theatrical lighting contractor to request this information.
 5. All low voltage control wiring shall be integral to the box and shall be isolated from the high voltage wiring by a low voltage barrier.
 6. All network connectors to be uniquely labeled using LTIE.XX. Label to contain the run length of the network cable and the maximum length of extension cable allowed between the network jack and any device connected to the jack.
 7. Relay panel circuits shall be labeled indicating what source(s) they are fed from located adjacent to the utility circuit receptacle. It is the responsibility of the theatrical lighting contractor to request this information.
 8. Relay panel circuits and numbering shall be located as noted on drawings
- J. Network/AC Plug In Panel (Quantity: 5)
1. ETC or approved equivalent.
 - a. BB.LWP.01 thru 05:
 - 1) 1 - 120V util ckt to 1 – 5-20 flush duplex receptacle and 1 – Ethercon network control receptacle.
 2. Provide this as a flush wall plate mountable in a standard 2 Gang (Deep) backbox supplied by others.
 3. Panel labelling TBD.
- K. Ellipsoidal Theatrical Lighting Instrument (Quantity: 20)

1. ETC ColorSource Spot V w/shutter assembly or approved equivalent.
 - a. 19° - 0
 - b. 26° - 20
 - c. 36° - 10
 - d. 50° - 0
 2. Provide complete with c-clamp, gel frame, safety cable and 3' lead terminated to a NEMA 5-15P.
 3. Refer to Theatrical Lighting Plan for hang and focus details.
 - L. Fresnel Theatrical Lighting Instrument (Quantity: 20)
 1. ETC ColorSource Fresnel V or approved equivalent.
 2. Provide complete with c-clamp, gel frame, safety cable and 3' lead terminated to a NEMA 5-15P.
 3. Refer to Theatrical Lighting Plan for hang and focus details.
 - M. DMX Extension Cable (Quantity: 52)
 1. 5' - 0
 2. 10' - 0
 3. 15' - 40
 4. 25' - 12
 5. Cables shall be labeled for length using appropriately sized self-adhesive numbers 3" from both connector ends covered by clear heat shrink tubing.
 6. Cables shall be supplied with one (1) appropriately sized Velcro cable tie.
 7. Cables shall be black.
 8. Cable shall be constructed according to USITT DMX512/1990 standard.
 9. Cables shall be constructed with one (1) 5 pin XLR Male connector and one (1) 5 pin XLR Female connector.
 - N. 20A PowerCon TRUE1 Extension Cable (Quantity: 52)
 1. 5' - 0
 2. 10' - 0
 3. 15' - 40
 4. 25' - 12
 5. Cables shall be labeled for length using appropriately sized self-adhesive numbers 3" from both connector ends covered by clear heat shrink tubing.
 6. Cables shall be supplied with one (1) appropriately sized Velcro cable tie.
 7. Cables shall be black.
 8. Cable shall be constructed using 12/3 SJOO-W cable.
 9. Cables shall be constructed with PowerCon TRUE1 connectors rated for 120vac @ 20amp loads.
 - O. 3' Molded Cat6 Patch Cable (Quantity: 24)
 - P. Gobo Holder (Quantity: 12)
 1. ETC 400PH-A or approved equivalent.
 - Q. Steel Gobo, A size (Quantity: 24)
 1. Patterns TBD.
 - R. Color Media:
 1. Provide a color media allowance for 4 - 20" x 24" sheets of R119.
- 2.7 RIDGE HS BLACK BOX - ARCHITECTURAL LIGHTING CONTROL SYSTEM
- A. Vacancy Sensor (Quantity: 4)
 1. ETC EVAC-SR-4 small room vacancy sensor or approved equivalent
 2. Color to be black.
 - B. Touch Screen / Controller (Quantity: 1)
 1. ETC ETS-4 EchoTouch MK2 controller or approved equivalent
 - C. Architectural Entry Station (Quantity: 2)
 1. ETC E10002-4 2 button Inspire or approved equivalent

2. Color to be black.
- D. Interface Station (Quantity: 1)
 1. ETC EACC-4 Echo Access Interface or approved equivalent
 2. Color to be black.
- E. Architectural Power Module (Quantity: 1)
 1. ETC E-SPM-A Unison Drd Echo Station Power Module with Auxilliary Station Power or approved equivalent
- F. Emergency Bypass Detection Kit (Quantity: 1)
 1. ETC Emergency Bypass Detection Kit EBDK
- G. Emergency Bypass DMX Controller (Quantity: 1)
 1. ETC DMX Emergency Bypass Controller DEBC-1

PART 3 - EXECUTION

3.1 GENERAL

- A. Coordinate work with other trades to avoid causing delays in construction schedule.
- B. Mount equipment and enclosures plumb and square. Permanently installed equipment shall be firmly and safely held in place.
- C. Cover edges of cable pass-through holes in chassis, racks, boxes, etc., with rubber grommets or Brady GRNY nylon grommeting.
- D. Mount equipment in racks and consoles and fully wire and test before delivery to job site. If field conditions prevent prior assembly of racks, notify Consultant in writing that racks will be fabricated on site and the reasons for the change.

3.2 CONTRACTOR/THEATRICAL LIGHTING CONTRACTOR INSTALLATION

- A. Confirm by site visit and by report from electrical contractor all field conditions, which may affect manufacture and installation of the Theatrical and Architectural Lighting Systems equipment prior to fabrication. Provide any additional hardware, panels and backboxes to accommodate field conditions. Submit all changes to equipment and mounting details to Consultant for review prior to fabrication.
- B. Supply specific, detailed direction to electrical contractor as required for proper installation of all Theatrical and Architectural Lighting System equipment, coordinated with actual site conditions.
- C. The Theatrical Lighting Contractor shall furnish all items required to properly install and secure Theatrical and Architectural Lighting System equipment in place.
- D. The electrical contractor shall place, install, and connect all Theatrical Lighting System equipment with the following exceptions:
 1. Theatrical and architectural control wire terminations.
 2. Theatrical fixtures set up, hang, and focus.
 3. Theatrical control console set up and programming.
 4. Architectural control station install, setup, and programming.
- E. If any panel, distribution box, or other device requires relocation or change of mounting detail, and this fact is not known until after shipment due to sequence of work, modify equipment or provide new equipment to fit revised location or mounting detail. Notify Consultant of any such changes and submit all changes to Consultant for review prior to fabrication.
- F. The Theatrical Lighting Contractor shall terminate all control wire in dimmer banks and all control panels.
- G. All control cables within the system shall be labeled with a unique identifying number at each end of the cable. Use only pre-printed labels. Cover labels with clear heat shrink tubing. Self-adhesive labels will not be allowed without prior approval of Consultant.

- H. Provide a service loop for all control cables and harness in place where applicable. No splices shall be allowed inside of control panels or racks. Provide terminal strips secured to panel or rack frame for all connections.
- I. Supply GC with all paint and supplies to correct minor cosmetic damage to equipment. Ensure that all equipment is clean and in perfect condition at time of Completion Checkout.
- J. Repair or replace any equipment, which has suffered non-cosmetic damage prior to time of Completion Checkout. Claims arising from repair or replacement of such damage shall be considered only after final acceptance of system by Owner.
- K. The contractor shall clean all racks, panels, and boxes of dirt, dust and debris, re-assemble all equipment, and replace all panels, covers and screws prior to time of Completion Checkout.
- L. Contractor shall not use any control equipment intended for installation for purpose of checking out wiring or circuitry prior an on-site factory trained technician testing the system (as specified above). Equipment may be used for such testing only in specific areas where proper conditions exist.
- M. Any existing equipment that is not required for the renovation to be salvaged by contractor/electrical contractor/theatrical lighting contractor and turned over to owner.

3.3 THEATRICAL LIGHTING CONTRACTOR TESTS AND ADJUSTMENTS

- A. Lamp all fixtures with the specified lamps and where applicable bench focus fixtures to a flat, even field.
- B. Hang, focus and color all lighting fixtures according to the Theatrical Fixture Layout drawing.
- C. Set up lighting control console and all related peripheral devices to include soft patching the console according to supplied paperwork.
- D. Set up and programming of architectural lighting control system and all related peripheral devices.
- E. Prior to energizing Production Lighting control systems, perform complete system checkout to verify that all items are correctly installed and shall safely operate as specified herein.
- F. Perform all tests and adjustments specified below upon Completion of installation of Production Lighting System.

3.4 TEST EQUIPMENT

- A. The following equipment shall be available for field-testing. Submit for approval, as a portion of the tender, list of test equipment.
 - 1. Ethernet Network cable and termination Qualifier
 - 2. DMX512 Protocol Tester.
 - 3. True RMS Multimeter, and clamp on ammeter.
 - 4. Circuit tester with adapters for all power receptacles provided in this section.
 - 5. Appropriate loads to test 100% of Theatre Lighting Circuits.
 - 6. Theatrical Lighting Contractor shall provide all appropriate adapters, extension cables and connectors necessary to interconnect test equipment to Theatrical Lighting system, and to perform all tests described below.
 - 7. Theatrical Lighting Contractor shall provide sufficient field service personnel (minimum of 2) to perform all tests specified below. Coordinate with the Division 26 contractor and to assist in all tests specified below. The contractor shall provide ladders and other devices, including 4 walkie-talkies, to allow access to all devices to be tested and communication between parties.

3.5 TEST PROCEDURES

- A. Perform all following tests & provide a written test report to the consultant:

1. Test all low voltage DMX/Architectural/Network circuits for proper wiring/termination, cable length, cable faults, Power Over Ethernet (POE) quality, and inducted voltage. Qualify Network circuits for Full Duplex 100BASE-TX operation. All Network tests to be executed after all Building Systems have been energized and are operating. Provide a written report of all test results organized by box/location.
 2. Inspect all device labels to ensure that devices are correctly and clearly labeled as specified and shown in specifying consultant approved submittal drawings.
 3. Test all line voltage circuits for proper wiring, polarity, connection to proper dimmer, and inspect for correct labeling.
 4. Test all power receptacles provided in this section.
 5. Test all Control Console operations.
 6. Test all control panels for all functions.
 7. Test all functions of all remote devices and all control plug-in points. When remote devices are NIC, but accommodations for these devices are included, provide identical devices for testing purposes.
 8. Test Control Console video systems for clear screen and high resolution of characters.
 9. Test all extension cables, adapters, etc.
 10. Perform visual testing of LED fixture dimming curves and consistency of dimming across all fixtures.
- B. Repair or replace any equipment that fails to conform to specification, and schedule second set of tests and adjustments. Provide test equipment and personnel specified above.
- C. Repeat testing and repair or replacement as required ensuring that the entire Theatrical Lighting System conforms to specification.
- D. Upon completion of testing, furnish Owner and Consultant a complete report on all field-testing and adjustment, certifying that system conforms to specification and that installation is complete and ready for inspection.

3.6 ACCEPTANCE

- A. Schedule inspection by Owner and Consultant no earlier than their receipt of above specified report.
- B. Provide all test equipment and personnel specified in "Field Testing and Adjustment" above.
- C. Coordinate with GC to ensure that no other work shall be scheduled in audience chamber or stage areas, and that all temporary bracing and scaffolding has been removed to permit full operation of and access to all equipment.
- D. At request of Consultant, repeat any and all test specified in "Field Testing and Adjustment" above in presence of Owner and Consultant.
- E. Should Owner or Consultant judge that any equipment fails to conform to specification, repair or replace that equipment within 30 days, and schedule second inspection. Should the Owner or Consultant judge that any work inspected is not substantially complete at time of Completion Checkout, schedule second inspection. Provide all equipment and personnel specified above.
- F. Schedule additional checkouts as required until Owner and Consultant judge entire Theatrical Lighting System to conform to specification.

3.7 INSTRUCTION OF OWNER PERSONNEL

- A. Provide four hours instruction to Owner designated personnel on the use and operation of the System, scheduled as one session, by an instructor fully knowledgeable and qualified in system operation. This instruction should include familiarization with all system components and basic operation of the lighting control console and architectural control system. The owner may record the instruction session at their cost. The System Reference Manuals shall be complete and on site at the time of this instruction.
- B. The lead technician for the project installation shall be present at the first two formal uses of the system.

END OF SECTION

SECTION 11 61 33 - RIGGING SYSTEMS AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Construction Contract, including General Conditions and Division 1 Specification Sections, apply to this Section.
- B. Theatrical rigging system drawings (TE series).

1.2 SCOPE

- A. Intent: This specification covers the fabrication, furnishing, delivery, and installation of the Theatrical rigging system. The form of contract, general conditions, and the project drawings are considered to be parts of these specifications.
- B. Complete System: The Rigging Contractor shall provide all items necessary for a complete, safe, fully functional system as described herein, including all tools, scaffolding, labor, and supervision, even though they may not be specifically enumerated. Any errors, omissions or ambiguities do not relieve the Contractor of this responsibility but shall be brought to the attention of the Architect for clarification.
- C. Work Included: The work of this section shall include, but not necessarily be limited to the following:
 - 1. Cable Management
 - 2. Theatrical Curtains, Tracks and Accessories
 - 3. Theatrical Lighting Pie Grid
- D. Related Work: Related work which is not included in this section:
 - 1. Gridiron, head and loft block beams, and all other structural steel and miscellaneous metals not specifically called out as part of this section.
 - 2. Galleries, ladders and catwalks.
 - 3. Stage flooring.
 - 4. Theatrical lighting.
 - 5. Electrical connections, conduit, boxes and wiring of any type.

1.3 GENERAL REQUIREMENTS

- A. Field Conditions: All bidders shall fully inform themselves of the conditions under which the work is to be performed. No additional compensation shall be allowed for any labor or item the bidder could have been fully informed of prior to the bid date.
- B. Safety: The systems shall conform to all applicable code requirements and shall be in conformance with industry standards of operation and practices. All materials, arrangements, and procedures shall comply with applicable code requirements, allowing the users to arrange and operate a safe assembly and working environment for audience and user personnel.
- C. Insurance: In the absence of more stringent requirements, the Rigging Contractor shall maintain injury and property liability insurance coverage throughout the project's scheduled timetable, including workmen's compensation coverage for Contractor's employees.

1.4 RESPONSIBILITY AND RELATED WORK

- A. The Theatrical Rigging Contractor shall be responsible for the following:
 - 1. Coordinate with the project Structural Engineer and verify the load capacities of the building structure where it interfaces with the rigging system.
 - 2. Provide all miscellaneous steel required for support of the Theatrical rigging system.
 - 3. Perform regular site visits (minimum of one monthly) after steel erection is completed to provide coordination with all other trades that may conflict with the installation and operation of the rigging system.
 - 4. Provide regular reports of all site visits to the Architect, Client, and Consultant that document all coordination issues and their resolutions in regards to the rigging system.

5. Provide and install all rigging system components.
 6. Terminate all control distribution cable, which shall be done in accordance with the manufacturer's specification.
 7. Furnish to the Electrical Contractor for installation all line level components and their housings.
 8. Provide a factory trained technician for system commissioning, including inspection, testing, and programming for the complete project.
 9. Provide shop drawings, As-built drawings, owner training, and operation manuals.
 10. Provide accessories and minor equipment items needed for a complete system, even if not specifically mentioned herein or in the drawings, without claim for additional payment.
 11. Assume responsibility for all engineering of systems described herein, including modification of and addition to any details as required in order to fulfill the design intent of the theatrical rigging system contract documents.
 12. Furnish sufficient workmen to operate all equipment and to assist in all tests specified. Provide ladders and other access devices, including 4 walkie-talkies, to allow access to all devices to be tested and communication between parties.
 13. Contractor shall obtain all licenses and permits necessary for the execution of any work pertaining to the installation within this scope of work.
- B. The Electrical contractor shall be responsible for the following:
1. Provide, install, and terminate all high voltage feeder circuits for the theatrical rigging system.
 2. Provide and install all low voltage control cabling.
 3. Provide and install all conduit, junction boxes, electrical wireways, and cable trays required for the rigging power and control systems.
 4. Pull all high voltage and low voltage cable in conduit.
 5. Provide sufficient workmen to assist Theatrical Rigging Contractor with system troubleshooting at first system energization.
 6. Clean all racks, panels, and boxes of dirt, dust and debris, re-assemble all equipment, and replace all panels, covers and screws prior to time of Completion Checkout.

1.5 REFERENCES

- A. International Building Code
- B. Underwriters Laboratories (U.L.)
- C. Occupational Safety and Health Administration (O.S.H.A.)
- D. National Fire Protection Association (N.F.P.A.).
- E. National Electrical Code (N.E.C.).
- F. American National Safety Institute (A.N.S.I.).
- G. Electronics Industries Association (E.I.A).
- H. TX State and City of Houston Building Code.
- I. National Electrical Manufacturers Association. (N.E.M.A.)
- J. Entertainment Services and Technology Technical Standards (E.S.T.A.)

1.6 SUBMITTALS

- A. Product Data: Submit manufacturer's product data sheets for each item of equipment in accordance with Division 1 of the project manuals. Data submittals shall be highlighted, alphabetized and tabbed. The Theatrical Rigging Contractor shall also provide a table of contents and quantities for all equipment.

- B. Shop Drawings: Indicate complete details and dimensions of work to be performed and indicate types and locations of equipment, fabricated equipment, and other details to completely describe work to be performed. Provide one PDF electronic file of submittal drawings for review. Keep a complete set of approved shop drawings on the job at all times. Non-approved shop drawings will not be allowed on the job site. Note any changes made during installation on a single set of drawings. This set of marked up drawings will not leave the jobsite until after the final system commissioning. Submit one PDF corrected electronic file set of drawings showing work as installed. All "as-built" drawings to be provided in PDF electronic form (ACAD 2000 or later). Details for both Shop/Submittal and As-Built drawings to include the following:
1. System control riser diagram
 2. Control wiring charts
 3. Wire numbers on all schematics/riser diagrams
 4. Rigging Equipment physical and electrical details
 5. Control systems physical and electrical details
 6. Other details or schematics required for systems operation
 7. All Rigging Submittals to be stamped by a licensed engineer licensed in the state of TX.
 8. Note: Consultant will supply AutoCAD files of system design, if requested.
- C. Contract Closeout Submittals:
1. Prepare and submit 3 copies of the System Reference Manual prior to Owner training in 3 ring binders, sized to hold the material plus 50% excess, with clear vinyl pockets on cover and spine for project title. Provide tabular dividers with permanent legends for the following sections:
 2. System Operation and Instructions- Prepare a complete and typical procedure for the operation of the equipment as a system, organized by subsystem or activity. This procedure should describe the operation of all system capabilities. Assume the intended reader of the manual to be technically inexperienced and unfamiliar with this facility.
 3. A list of all test results performed on the system as outlined in Section 3.
 4. A list of all equipment, indicating manufacturer, model, serial number, and equipment location (i.e. panel/rack/room number). Update following acceptance testing, if changed.
 5. A list of all settings of all semi-fixed controls. Update this document after the final acceptance testing.
 6. Photographically reproduced schematic wiring diagrams of the rigging system, based on the as-built documentation, at a reduced scale easy to handle but fully legible. Blueline (or similar diazo process) prints are not acceptable.
 7. Manufacturer's Instruction Manuals for all items of equipment, incorporating or followed by manufacturer's warranty statements. For custom circuits or modifications, a description of the purpose, capabilities, and operation of each item.
 8. Manufacturer's Service Manuals and parts list for all equipment. Photocopies are not acceptable. For custom circuits or modifications, complete schematics and parts lists.
 9. Maintenance Instructions, including Contractor's maintenance phone number(s) and hours; maintenance schedule, description of products recommended or provided for maintenance purposes, and instructions for the proper use of these products.
 10. A legend of acronyms and abbreviations must accompany all documentation.
 11. Replacement parts lists of major items of equipment.
 12. Provide written report for dates of replacement of all batteries. This is to include UPS, and control systems.
 13. Project record drawings "as-builts" to be provided within 4 weeks after system acceptance. Provide in PDF electronic form (ACAD 2000 or later, DWG or DXF files). See paragraph 1.6, item B above for further details.

1.7 QUALITY ASSURANCE

- A. Contractor's Qualifications: Have previously installed at least 4 jobs of similar magnitude, completed within the last five years. Provide name and phone number of reference for each representative project. Identify at least one such completed job available for inspection by Consultant or Owner's Representative.
- B. Bidder will confirm in writing that Sub-contractor firm has five years' experience with equipment and systems of the types specified, that the Sub-contracting firm maintains a fully staffed and equipped service facility, and that the firm is a franchised dealer and authorized service facility for the major brands specified, and that the firm is properly licensed to work in Houston, TX. Bidding contractor will identify all Sub-contractors on the Bid Response team and a detailed scope of work for each Sub-contractor.
- C. Provide a summary of experience of the project manager, lead engineer and lead installers assigned to this project. This will include key team members of any Sub Contractor. The on-site lead installer shall be an ETCP Certified Rigger.
- D. DELIVERY, HANDLING, STORAGE
- E. Comply with Division 1 General Conditions - Materials and Equipment section.

1.8 WARRANTY

- A. The Rigging Contractor shall provide a three year written guarantee against defects in materials or workmanship starting from the date of acceptance of equipment by the Owner's representative. The guarantee shall not cover damage due to normal wear and tear, acts of God, neglect, or improper use of equipment. Any required maintenance or replacement shall be provided by the Rigging Contractor within thirty days of notification by the Owner except for safety related items, which shall be corrected within 48 hours of notification. Subsequent to the expiration of the guarantee period the Rigging Contractor agrees to furnish repair and maintenance service, at the Owner's expense, within thirty days of request for such service. This warranty shall not void specific warranties issued by manufacturers for greater periods of time. Nor shall it void any rights guaranteed to the Owner by law.
- B. Theatrical Rigging Contractor to provide Owner with exact beginning and ending dates of the warranty period. Include the name of the person to call for service and telephone number. This information to be part of Project Record Drawings.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Standards:
 - 1. Materials shall conform to the following ASTM and ANSI standard specifications:
 - a. ASTM A-36 Specification for structural steel
 - b. ASTM A 47 Specification for malleable iron casting
 - c. ASTM A 48 Specification for gray iron casting
 - d. ASTM A 120 Specification for black and hot dipped zinc coated (galvanized) steel pipe for ordinary use
 - e. ANSI B18.2.1 & 2 Specification for square and hex bolts and nuts
 - f. ANSI E1.4-2009 Entertainment Technology – Manual Counterweight Rigging Systems.
 - g. ANSI E1.22 - 2009 Entertainment Technology - Fire Safety Curtain Systems
 - 2. In order to establish minimum standards of safety, the following factors shall be used:
 - a. Cables and fittings 8:1 Safety Factor
 - b. Cable bending ratio Sheave tread diameter is 26 times cable diameter
 - c. Maximum fleet angle 1 1/2 degrees
 - d. Steel 1/5 of yield
 - e. Bearings Two times required load at full speed for 2000 hours
 - f. Bolts Minimum SAE J429 Grade 5 (ISO R898 Class 8.8), zinc plated
 - g. Motors 1.0 Service Factor

- h. Gearboxes - 1.25 Mechanical Strength Service Factor
- B. Materials: All materials used in this project shall be new, unused and of the latest design. Re furnished and obsolete materials are not permitted.
- C. Sheaves:
1. Sheaves shall be one of the following materials:
 - a. ASTM A-48 Class 30 grey iron castings
 - b. Nylatron or Polyamide Nylon (PA6-G)
 - c. Steel
 2. Groove depths shall be sufficient to encompass fully the cables and ropes. Grooves shall have sloped sides (8 degree minimum) and conform to rope and cable manufacturers' standards for groove shape and tolerance.
 3. Sheaves shall be supported by bearings and a machined steel shaft, which shall be keyed to one side plate to prevent rotation. Proper adjustment of the bearing shall be accomplished by means of a fine thread, self-locking nut on the opposite end of the shaft. Each sheave shall run plumb and true without rubbing its side plates when rotated.
- D. Fabrication:
1. All manufactured equipment that is dependent on field conditions shall have those conditions field verified prior to fabrication and installation of all equipment. Notify Consultant of any discrepancies in site conditions or design documents as soon as identified.
 2. The mechanical fabrication and workmanship shall incorporate best practices for good fit and finish. There shall be no burrs or sharp edges to cause a hazard nor shall there be any sharp corners accessible to personnel.
 3. All moving parts shall have specified tolerances. Sheaves shall run plumb and true and shall not scrape housings.
 4. All equipment shall be built and installed to facilitate future maintenance and replacement.
- E. Finishes:
1. Paint shall be the manufacturer's standard finish and color except as noted.
 2. All turnbuckles, clips, tracks, chains and other items of incidental hardware shall be furnished plated or painted.
- F. Recommended Working Load: This specification calls for minimum recommended working loads for many hardware items. This is the maximum load which the manufacturer recommends be applied to properly installed, maintained, and operated new equipment. Manufacturer's recommended working loads shall be determined by calculations by a Licensed Professional Engineer and destructive testing by an independent testing laboratory. These calculations and reports shall be available for review.
- G. Materials and products required for work of this section shall not contain asbestos, polychlorinated biphenyls (PCB) or other hazardous materials identified by the Owner.

2.2 ACCEPTABLE MANUFACTURERS

- A. The following manufacturers of Theatrical Rigging equipment shall be considered pre-Qualified to supply Theatrical Rigging equipment.
1. H & H Specialties, Inc
 2. Wenger / J.R. Clancy, Inc.
 3. SSRC
 4. Thern
- B. Additional qualified manufacturers will be considered subject to review by the Owner and Consultant. The Contractor will supply complete technical data specifications at the time of proposed substitution. The Contractor will arrange for product demo at the request of the owner and will pay ground freight shipping to and from site, or to and from Consultant's office. The Owner reserves the right to accept or refuse any substitution without condition.
- C. Substitutions: Comply with Division 1 General Conditions – Substitutions section. Any proposed substitutions must meet all specifications of the specified equipment. No product substitution will be accepted without the written approval of the Consultant and Owner.

- D. The manufacturer must have a product testing program, including determination of recommended working loads for products based on destructive testing by an independent laboratory and review by an independent licensed engineer. Approval to bid does not release the manufacturer from meeting this requirement.
- E. Requirements for Approval to bid: Equipment manufacturers seeking approval must submit the following information at least 2 weeks prior to the bid opening date. Failure to submit any of the required information will automatically disqualify the manufacturers from consideration of approval.
 - 1. Evidence that the manufacturer has been in business for a minimum of eight years manufacturing Theatrical equipment.
 - 2. A listing of 8 equivalent installations including:
 - a. Name, address, and telephone number of Owner.
 - b. Name, address, and telephone number of Architect.
 - c. Scope of work.
 - 3. A brief written description of the manufacturer's operation including facilities, financial capabilities, and experience of key personnel.
 - 4. A statement from an insurance company indicating that the manufacturer carries primary product and general liability insurance of \$2,000,000 each, with excess liability coverage of \$10,000,000.
 - 5. A description of their details of their product testing program and methods along with the names and telephone number of the independent test lab and licensed professional engineer performing the product testing and review.
- F. Equipment and materials shall be new, and conform to applicable UL, CSA, or ANSI provisions. Take care during installation to prevent scratches, dents, chips, etc.
- G. The Theatrical Rigging Contractor shall verify all site conditions prior to fabrication and installation of all equipment. Notify Consultant of any discrepancies in site conditions or design documents as soon as identified.
- H. Use only components and items in the theatrical rigging systems that conform to industry practice and acceptable code standards.
- I. Wiring of power distribution cable shall be in accordance with the electrical engineer's specification.
- J. Wiring of control distribution cable shall be in accordance with the manufacturer's specification.
- K. Installation of theatrical rigging support steel shall be in accordance with the structural engineer's specification.

2.3 RIDGE HS BLACK BOX

- A. Theatrical Lighting Pipe Grid (Quantity: 1)
 - 1. Provide a Lighting grid and associated mounting hardware for the theatrical lighting instruments to be mounted in the Stage Pipe grid position. The grid shall be ~47' x 43'-7" long. The grid shall be built with a 4' x 4' pipe spacing. See drawings TEC-451-G for detail.
 - 2. All pipes shall be 1 ½" Schedule 40 black seamless steel/iron pipe, treated to prevent corrosion. Pipe shall have a nominal OD of 1.9".
 - 3. All pipe crossovers shall be secured using pipe cross clamps.
 - 4. Co-ordinate all miscellaneous support steel requirements with the General Contractor.
 - 5. Co-ordinate installation of pipes and mounting hardware with Division 26 Contractor.
 - 6. Co-ordinate color of pipes and mounting hardware with the Specifying Lighting Consultant and Client.
 - 7. Co-ordinate location of support pipes and mounting with the Specifying Lighting Consultant and Client.
 - 8. All dimensions and conditions must be field verified before installation.

9. Retain the services of a registered professional structural engineer, licensed to practice in Houston, TX to oversee and certify the design, development, fabrication and installation of the support pipes and associated rigging/mounting hardware. This does not include any required miscellaneous steel or structural supports that the support pipes are rigged/mounted to which are the responsibility of the projects structural engineer, architect and contractors other than the theatrical rigging vendor.
- B. Theatrical Curtains and Accessories
1. Walk Along Operated Traveling Curtain Track (Quantity: 5)
 - a. Provide curtain track complete with all necessary accessories for walk along operation located in the plan North, South, East and West A & B wall positions. Tracks to be ~43'6", ~39'-9", ~36', ~6' and ~26'6" long respectively. Refer to TE series drawings.
 - b. Suspend track with two-piece clamp hanger. Install end stop at each track end. Where lengths exceed 24', connect tracks with minimum 12" long, two-piece splicing clamp.
 - c. Provide single carriers, spaced on 12" centers, constructed of two polyethylene wheels fastened parallel to shielded ball bearing carrier body and supplied with heavy-duty hook, swivel eye and trim chain for attachment of curtain. Black nylon shall be molded around shielded and greased ball bearing to form carrier body. Install round neoprene bumper between each carrier to reduce noise.
 - d. Track shall be finished with a semi-gloss black powder coat. All other steel components shall be black oxide finished.
 - e. Curtains per drapery schedule in paragraph 2.03, B, 2, b.
 2. Stage Drapery and Drops
 - a. Stage Curtain Construction
 - 1) Verify Drapery Measurements in Field before construction.
 - 2) All draperies must be either inherently flame retardant (IFR) or vat dyed and flame retarded (FR) by an immersion process.
 - 3) All fabric cuts must be full length with no splices. Any fabric sections with visible streaking or spotting must be cut from bolt and discarded.
 - 4) All Stage curtains furnished with sewn fullness must be box-pleated on 12-inch centers.
 - 5) All top hems must have a heavy-duty jute webbing double stitched at the top with machine set brass grommets one foot on center with tie lines or snap hooks as required.
 - 6) All draperies must have, as a minimum, 50% fullness unless otherwise specified.
 - 7) All hems must be double turned with no visible selvage edges.
 - 8) On-stage and off-stage vertical hems of Main Curtain and Traveler Curtains must have 1/2 bolt width turned back hems. All other vertical hems must be 3 inches.
 - 9) Floor length draperies must have a 6-inch bottom hem with a suspended inner canvas or muslin pocket containing #8 zinc plated chain weights.
 - 10) Bottom hems of border curtains must be 4 inches.
 - 11) All fabrics with pile ends must be sewn with pile running down unless otherwise specified.
 - 12) Lining fabric (if required) shall be attached to the face fabric of the drape using short nylon webbing strips tacked along the bottom and sides of the curtain.
 - 13) All fabrics must be either inherently flame retardant or flame proofed using an immersion process. This process must be in accordance with the requirements of the NFPA 701 Large and Small scale test.
 - b. Drapery Schedule
 - 1) 4 each - Masking Leg Curtain from 21 oz IFR Polyester Velour, in one section ~14'6" high X 11'0" wide. Provide curtain with snap hooks at top. Color to be black.
 - 2) 9 each - Masking Leg Curtain from 21 oz IFR Polyester Velour, in one section ~14'6" high X 10'0" wide. Provide curtain with snap hooks at top. Color to be black.
 - 3) 1 each - Masking Leg Curtain from 21 oz IFR Polyester Velour, in one section ~14'6" high X 8'0" wide. Provide curtain with snap hooks at top. Color to be black.

- 4) 2 each - Masking Leg Curtain from 21 oz IFR Polyester Velour, in one section ~14'6" high X 6'0" wide. Provide curtain with snap hooks at top. Color to be black.

PART 3 - EXECUTION

3.1 GENERAL

- A. Coordinate work with other trades to avoid causing delays in construction schedule.
- B. Mount equipment and enclosures plumb and square. Permanently installed equipment shall be firmly and safely held in place.

3.2 CONTRACTOR/THEATRICAL RIGGING CONTRACTOR INSTALLATION

- A. Confirm by site visit and by report from general and electrical contractor all field conditions, which may affect manufacture and installation of the Theatrical Rigging Systems equipment prior to fabrication. Provide any additional hardware to accommodate field conditions. Submit all changes to equipment and mounting details to Consultant for review prior to fabrication.
- B. The Theatrical Rigging Contractor shall furnish all items required to properly install and secure Rigging System equipment in place.
- C. Repair or replace any equipment, which has suffered non-cosmetic damage prior to time of Completion Checkout. Claims arising from repair or replacement of such damage shall be considered only after final acceptance of system by Owner.
- D. The Theatrical Rigging Contractor in coordination with the Project General Contractor shall clean all pipe grid components of dirt, dust and debris prior to time of Completion Checkout.

3.3 THEATRICAL RIGGING CONTRACTOR TESTS AND ADJUSTMENTS

- A. Verify that all termination hardware is installed to specification.

3.4 TEST EQUIPMENT

- A. The following equipment shall be available for field-testing. Submit for approval, as a portion of the tender, list of test equipment.
 1. Torque Wrench
 2. Compression sleeve test gage.

3.5 TEST PROCEDURES

- A. Perform all following tests & provide a test report to the consultant:
 1. Measure Torque of all bolted connections to verify if they meet manufacturer's specification.
 2. Measure all Compression sleeve connections to verify if they meet manufacturer's specification.
 3. Repair or replace any equipment that fails to conform to specification, and schedule second set of tests and adjustments. Repeat testing and repair or replacement as required to make the entire Theatrical Rigging System conform to specification.
 4. Upon completion of testing, furnish Owner, Architect and Consultant a complete report on all field-testing and adjustment, certifying that system conforms to specification and that installation is complete and ready for inspection.

3.6 ACCEPTANCE

- A. Schedule inspection by Owner, Architect and Consultant no earlier than upon receipt of above specified report.
- B. Provide all test equipment and personnel specified in "Field Testing and Adjustment" above.
- C. Coordinate with GC to ensure that no other work shall be scheduled in audience chamber or stage areas, and that all temporary bracing and scaffolding has been removed to permit full access to all equipment.

- D. At request of Consultant, repeat any and all tests specified in "Field Testing and Adjustment" above in presence of Owner, Architect and Consultant.
- E. Should Owner, Architect or Consultant judge that any equipment fails to conform to specification, repair or replace that equipment within 30 days, and schedule second inspection. Should the Owner; Architect or Consultant judge that any work inspected is not substantially complete at time of Completion Checkout, schedule second inspection. Provide all equipment and personnel specified above.
- F. Schedule additional checkouts as required until Owner, Architect and Consultant judge entire Rigging System to conform to specification. After Completion Checkout, compensate Owner for any consulting and transportation costs incurred during subsequent checkouts. Final payment shall be withheld until systems have been thoroughly tested and adjusted and found to be in first class operating condition in every particular.

END OF SECTION

SECTION 11 66 00 - ATHLETIC EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: The following types of athletic equipment as shown on the Drawings:
 - 1. Basketball/Volleyball/Wrestling scoreboards.
 - 2. Football/Soccer scoreboards.
- B. Related Sections:
 - 1. Section 03 30 00 - Cast-in-Place Concrete: For goal posts set in concrete footings.
 - 2. Section 11 68 23: Tennis Equipment.

1.2 QUALITY ASSURANCE

- A. For installation use only personnel who are skilled in the work required.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Product data on physical characteristics and durability characteristics for each type of gymnasium equipment and accessory specified.
- C. Installation Methods: Submit two copies of manufacturer's recommended installation method showing all requirements for blocking and bracing.
- D. Shop drawings showing location and extent of athletic equipment and accessories. Include plans, elevations, large-scale details of anchorages, and accessory items.
- E. Indicate unit conditions at openings, typical and special details, and location and installation requirements for hardware and operators.
- F. Provide dimensioned locations of volleyball inserts to General Contractor for locating thickened slab areas.
- G. Template drawings prepared by manufacturer showing location of items supported or anchored by permanent construction.

1.4 PRODUCT HANDLING

- A. Protection: Protect equipment before, during and after installation. Protect installed work of other trades.
- B. Replacements: In event of damage, make necessary replacements.

1.5 WARRANTY

- A. Manufacturer's standard warranty agreeing to repair or replace scoreboards and LED lights that fail in material or workmanship within the specified warranty period.
1. Warranty Period - Scoreboards: 5 years from date of Substantial Completion.
 2. Warranty Period - LED Lights: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Unless otherwise indicated, provide Athletic Equipment by the following manufacturers:
1. Spectrum Scoreboards (scoreboards), www.spectrumscoreboards.com.
 2. Substitutions: Section 01 60 00 - Product Requirements.

2.2 MATERIALS:

- A. Scoreboards:
1. General
 - a. UL Listed / CSA Certified.
 - b. MSX multi-sport controller for separate use of each scoreboard, keyboard overlays, and carrying case.
 - c. Power Requirements: 120 V, 60 Hz, earth ground.
 - d. Cabinet Construction: 0.050 inch aluminum sheet with mill finish.
 - e. Face Construction: 18-gauge galvanized steel sheet with factory two-component polyurethane finish.
 - f. Colors: Custom 2-color face with mascot, colors to be selected.
 2. Basketball Scoreboards
 - a. Basis-of-Design: Spectrum Model 5250.
 - b. Size: Nominal 12'L x 6'H x 5"D.
 - c. Display Panel:
 - 1) 18 inch high LED numbers for clock and scores.
 - 2) 14 inch high LED numbers for fouls, period, player no.
 - 3) Painted letters including:
 - a) "CY RIDGE" (in lieu of "Home")
 - b) "VISITORS"
 - c) "PERIOD"
 - d) "FOULS" per each team.
 - e) "PLAYER" and "FOULS"
 - d. Display Information:
 - 1) 99 minute clock in minutes and seconds.
 - 2) Home and Visitor Scores 0-199.
 - 3) Period.
 - 4) Bonus, Double Bonus, and Possession Indicator for each team.
 - 5) Team Fouls.
 - 6) Player Fouls.
 - e. LED digits protected by 1/8" Lexan cover.
 - f. Low-voltage multi-sport controller with 10 foot long cable (wireless not allowed) and carrying case.
- B. Football/Soccer Scoreboards:

1. Basis of Design: Spectrum Model 11020-P4.
2. Size: Nominal 20'L x 8'H x 5"D.
3. Display Panel:
 - a. 30 inch high LED numbers for clock.
 - b. 24 inch high LED numbers for scores.
 - c. 21 inch high LED numbers for quarter, down, and yards-to-go for first-down.
 - d. Painted letters including:
 - 1) "CY RIDGE" (in lieu of "Home")
 - 2) "VISITORS"
 - 3) "QTR"
 - 4) "DOWN"
 - 5) "TO GO"
 - e. Display Information:
 - 1) 99 minute clock in minutes and seconds.
 - 2) Home and Visitor Scores 0-99.
 - 3) Automatic clock reset and period advance
 - 4) Possession Indicator for each team.
 - f. Lampbank sun filter screens.
 - g. Low-voltage multi-sport controller with 10 foot long cable (wireless not allowed) and carrying case.

PART 3 - EXECUTION

- 3.1 Inspection: Inspect installed work of other trades and verify that such work is complete to a point where this work may commence. Verify that installation may be made in accordance with approved shop drawings and manufacturer's instructions.
 - A. Discrepancies: In event of discrepancy, notify Architect. Do not proceed with installation until discrepancies have been resolved.
- 3.2 Installation: Install where indicated, anchoring all components firmly in place in complete accordance with approved shop drawings and the manufacturer's recommendations.
- 3.3 Volleyball Equipment: Assemble all equipment and demonstrate to Owner's representatives at time of acceptance.
- 3.4 Demonstrate operation of all scoreboards to Owner's representatives at time of acceptance.

END OF SECTION

SECTION 12 21 13 - HORIZONTAL LOUVER BLINDS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Horizontal slat louver blinds.
- B. Operating hardware.

1.2 SUBMITTALS

- A. Product Data: Provide data indicating physical and dimensional characteristics.
- B. Samples: Submit two samples, 6 inch long illustrating slat materials and finish, color, cord type and color.
- C. Manufacturer's Installation Instructions: Indicate special procedures.

1.3 PROJECT CONDITIONS

- A. Coordinate the work with window installation and placement of concealed blocking to support blinds.
- B. Take field measurements to determine sizes required.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Horizontal Louver Blinds:
 - 1. Hunter Douglas: www.hunterdouglas.com.
 - 2. Levolor Contract: www.levolorcontract.com.
 - 3. Graber, division of Springs Window Fashions: www.graberblinds.com.

2.2 BLINDS AND BLIND COMPONENTS

- A. Blinds: Horizontal slat louvers hung from full-width headrail with full-width bottom rail; manual control of raising and lowering by cord with full range locking; blade angle adjustable by control wand; complying with WCMA A100.1.
- B. Metal Slats: Spring tempered pre-finished aluminum; radiused slat corners, with manufacturing burrs removed.
 - 1. Width: 1 inch.
 - 2. Color: As selected.
- C. Slat Support: Woven polypropylene cord, ladder configuration.

- D. Head Rail: Pre-finished, formed aluminum box, with end caps; internally fitted with hardware, pulleys, and bearings for operation; same depth as width of slats
- E. Bottom Rail: Pre-finished, formed steel with top side shaped to match slat curvature; with end caps. Color: Same as headrail.
- F. Lift Cord: Braided nylon; continuous loop.
 - 1. Free end weighted.
- G. Control Wand: Extruded hollow plastic; hexagonal shape.
 - 1. Non-removable type.
 - 2. Length of window opening height less 3 inches.
 - 3. Color: As selected .
- H. Headrail Attachment: Wall brackets.
- I. Accessory Hardware: Type recommended by blind manufacturer.

2.3 FABRICATION

- A. Fabricate blinds to fit within openings with uniform edge clearance of 1/4 inch.
- B. Fabricate blinds to cover window frames completely.
- C. At openings requiring multiple blind units, provide separate blind assemblies with space of 1/2 inch between blinds, located at window mullion centers.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that openings are ready to receive the work.
- B. Ensure structural blocking and supports are correctly placed.

3.2 INSTALLATION

- A. Install blinds in accordance with manufacturer's instructions.
- B. Secure in place with flush countersunk fasteners.

3.3 INSTALLATION TOLERANCES

- A. Maximum Variation of Gap at Window Opening Perimeter: 1/4 inch.
- B. Maximum Offset From Level: 1/8 inch.

3.4 ADJUSTING

- A. Adjust blinds for smooth operation.

3.5 CLEANING

- A. Clean blind surfaces just prior to occupancy.

END OF SECTION

SECTION 12 35 51 - MUSICAL INSTRUMENT STORAGE CABINETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Musical instrument storage cabinet systems.

B. Related Sections:

1. Section 06 10 53 - Miscellaneous Rough Carpentry: Wood blocking for anchoring musical instrument storage cabinets.
2. Section 09 21 16 - Gypsum Board Assemblies: Reinforcing in gypsum board partitions for anchoring musical instrument storage cabinets.

1.2 REFERENCES

- A. American Laminators Assoc. Performance Standard ALA 1985.
- B. ANSI - BHMA Standard A156.9, Grade 1.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Product Data: For each type of product indicated.
- C. Shop Drawings: Show fabrication and installation details for musical instrument storage cabinets. Include plans, elevations, sections, details, and attachments to other Work.
- D. Samples: For each color and finish for each exposed casework component.
- E. Sample Warranty: For special warranty.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative of musical instrument storage cabinets manufacturer for installation and maintenance of units required for this Project.
- B. Source Limitations: Obtain musical instrument storage cabinets through one source from a single manufacturer.
- C. Product Designations: Drawings indicate sizes, configurations, and finish material of musical instrument storage cabinets by referencing designated manufacturer's catalog numbers. Other manufacturers' cabinets of similar sizes and door configurations, of same finish material, and complying with the Specifications may be considered.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
- B. Deliver musical instrument storage cabinets only after painting, utility roughing-in, and similar operations that could damage, soil, or deteriorate cabinets have been completed in installation areas. If cabinets must be stored in other than installation areas, store only in areas where environmental conditions meet requirements specified in "Project Conditions" Article.
- C. Keep finished surfaces covered with polyethylene film or other protective covering during handling and installation.

1.6 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.
- B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of institutional cabinets that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to, the following:
 - 1. Delamination of components or other failures of glue bond.
 - 2. Warping of components.
 - 3. Failure of operating hardware.
 - 4. Deterioration of finishes.
- C. Warranty Period: Three years from date of Substantial Completion.
- D. Warranty Period for Cabinet Shelving: Ten years from date of Substantial Completion.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install musical instrument storage cabinets until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
- B. Field Measurements: Where musical instrument storage cabinets are indicated to fit to other construction, verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings.
 - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating musical instrument storage cabinets without field measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.8 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Coordinate layout and installation of metal framing and reinforcements in gypsum board assemblies for support of musical instrument storage cabinets.

1.9 SYSTEM DESCRIPTION

A. Design Requirements:

1. Provide one-piece high molecular polyethylene shelving with integral ventilation grooves, designed and engineered to withstand continuous use without surface or front edge breakdown.
2. Individual cabinets shall be manufactured with thermofused polyester laminated panels, finish both faces all components. All end panels to be factory jiggged and drilled to accept unit-to-unit through-bolting: no conventional wood screws attaching units side-to-side will be permitted. Each cabinet will be furnished with an integral base and four (4) steel levelers accessible from within the unit but concealed in final installation.
 - a. Provide inset style door panels, solid or wire grille as shown on drawings, or if not shown on drawings, provide wire grille doors minimum; reveal or full overlay style solid or wire grille doors will not be permitted due to inherent weakness of overlay hinges. All hinges shall be structurally attached to vertical panels using engineered and tested through-bolt hardware, and either welded to wire grille doors or through-bolted to solid door leaf; screw mounted hinges will not be permitted.

B. Manufacturer to Provide Documentation of Following Minimum Performance Requirements:

1. Molded plastic instrument storage shelf shall have a static load capacity of over 1,000 lbs.
2. Full height solid hinged door for instrument storage units will support a minimum dynamic live load of 315 lbs., applied at outer edge.
3. Wire grille door hinge to be welded to door frame in five places, pull-tested to withstand 3,000 lbs.

PART 2 - PRODUCTS

2.1 MUSICAL INSTRUMENT STORAGE CABINETS

A. Manufacturers:

1. LSI Corporation of America, www.lsi-casework.com
2. TMI Systems Design Corp., www.tmisystems.com
3. Wenger Corp., www.wengercorp.com
4. Substitutions: Section 01 60 00 - Product Requirements.

2.2 MATERIALS

A. Cabinet Wall Panels:

1. 3/4 inch thick industrial (cabinet) grade particleboard, minimum 48 pcf with thermoset polyester (melamine not acceptable) laminate on both sides for totally finished construction. No backer sheets or unfinished surfaces may be used on unexposed sides. Color: As selected by Architect from manufacturer's full line of standard and custom colors.
 - a. Interior Composite Wood Products: Contain no added urea-formaldehyde resins.

B. Cabinet Shelving:

1. Cabinets up to 27 inches wide: One-piece high molecular blow-molded polyethylene with 1-3/8 inch radius front edge. Mount to cabinet walls with one-piece molded rigid ST nylon clip. Shelf is replaceable without damage to adjacent surfaces. Doweled shelves will not be permitted.
2. Cabinets over 27 inches wide: One-piece high molecular formed polyethylene with radius front edge and 3/16" wall thickness. Ribbed for structural integrity. Supported by four structural tubular members 1-1/2" x 1" x 16 ga. wall thickness with 14 gauge welded end plates.

C. Doors:

1. Wood doors: Same construction as cabinet wall panels except finish – As selected by Architect from manufacturer's full line of standard and custom colors and finishes.
 - a. Hinges, 5-knuckle institutional type hinge, supplied by ISO 9002 vendor. Hinge will support 315 lbs. dynamic vertical load. Hinge pin shall be 2-3/4" long. Fastened to cabinet and door with through-bolt construction; attachment by wood screws not acceptable. Two hinges on compartment doors, four on full height doors. Finish: Manufacturer's standard powder coat.
2. Grille doors: Welded steel grille construction with powder coat finish, color as selected by Architect from manufacturer's full line of standard and custom colors. Welds at T-joints must be 360°.
 - a. Hinges, 5-knuckle institutional type hinge, supplied by ISO 9002 vendor. Hinge will support 315 lbs. dynamic vertical load. Hinge pin shall be 2-3/4" long. Hinge welded to door frame in five places. Fastened to cabinet with through-bolt construction; attachment by wood screws not acceptable. Finish: Manufacturer's standard powder coat. Provide two hinges on compartment doors, four on full height doors.
3. Locking slide-bolt: All doors shall be factory provided with locking slide-bolt designed for padlocks, with formed steel strike plate through-bolt connected to cabinet end panel; 12 gauge steel. Provide clear plastic label holder for identification card insert. Finish: Manufacturer's standard powder coat.
4. Edging: Heat bonded 3mm beveled PVC edge-banding, machine applied using hot-melt adhesives, edges and corners machine profiled for safety, integral color to match door panels.

D. Finish Hardware:

1. Joinery Hardware: Two inch, 1/4-20 panel connectors with 15 mm head diameter, and steel thread inserts shall be utilized to join desired cabinets side-to-side; use factory jigged and drilled joinery holes. Finish: Manufacturer's standard powder coat.
2. Cabinet levelers: Structural levelers each cabinet, accessible from within the unit when desired, concealed in complete installation; glides with minimum 3/8 inch diameter threaded rod mounted in steel corner brackets. Provide minimum four glides per cabinet, six glides for cabinets with divider panels.

E. Cabinet Back Panel: Standard cabinet back to be 1/4" thick prefinished hardboard, color: match interior of side and top panels.

1. Interior Composite Wood Products: Contain no added urea-formaldehyde resins.

F. Vertical Closure Kit: Provide visual closure between wall and cabinet. Constructed of 3/4" thick thermoset polyester composite wood to match cabinet side panels.

1. Interior Composite Wood Products: Contain no added urea-formaldehyde resins.

- G. Horizontal Closure Kit: Provide visual closure between top of cabinet and soffit. Constructed of 3/4" thick thermoset polyester composite wood to match cabinet side panels.
 - 1. Interior Composite Wood Products: Contain no added urea-formaldehyde resins.
- H. Top Back Filler Kit: Provide visual closure between back wall and top panel of cabinet. Constructed of 3/4" thick thermoset polyester composite wood to match cabinet top panels.
 - 1. Interior Composite Wood Products: Contain no added urea-formaldehyde resins.
- I. Finished Back Panel: Provide panel to attach to cabinet back that is exposed. Constructed of 1/2" thick thermoset polyester composite wood to match cabinet.
 - 1. Interior Composite Wood Products: Contain no added urea-formaldehyde resins.
- J. Base Molding: ASTM F 1861, Type TS (rubber, vulcanized thermoset), black, 4 inches high. Provide on fronts and exposed sides of floor-mounted cabinets.
 - 1. Style: A, straight with no toe.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances, location of reinforcements, and other conditions affecting performance of musical instrument storage cabinets.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 CABINETS INSTALLATION

- A. Install plumb, level, and true; shim as required, using concealed shims. Where musical instrument storage cabinets abut other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical.
- B. Base Cabinets: Set cabinets straight, level, and plumb. Adjust subtops within 1/16 inch of a single plane. Fasten cabinets to partition framing, wood blocking, or reinforcements in partitions with fasteners spaced 24 inches o.c. Bolt adjacent cabinets together with joints flush, tight, and uniform. Align similar adjoining doors and drawers to a tolerance of 1/16 inch.
 - 1. Where base cabinets are not installed adjacent to walls, fasten to floor at toe space with fasteners spaced 24 inches o.c. Secure sides of cabinets to floor, where they do not adjoin other cabinets, with not less than two fasteners.
- C. Wall Cabinets: Hang cabinets straight, level, and plumb. Adjust fronts and bottoms within 1/16 inch of a single plane. Fasten to hanging strips, masonry, partition framing, blocking, or reinforcements in partitions. Align similar adjoining doors to a tolerance of 1/16 inch.
 - 1. Fasten through back, near top and bottom, at ends, and not more than 16 inches o.c. with No. 10 wafer-head screws sized for 1-inch penetration into wood framing, blocking, or hanging strips; No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish; or toggle bolts through metal backing or metal framing behind wall finish.

D. Install hardware uniformly and precisely. Set hinges snug and flat in mortises, unless otherwise indicated. Adjust and align hardware so moving parts operate freely and contact points meet accurately. Allow for final adjustment after installation.

1. Adjust cabinets and hardware so doors and drawers operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.

3.3 CLEANING AND PROTECTING

- A. Repair or remove and replace defective work as directed on completion of installation.
- B. Clean finished surfaces, touch up as required, and remove or refinish damaged or soiled areas to match original factory finish, as approved by Architect.
- C. Protection: Provide 6 mil plastic or other suitable water-resistant covering over countertop surfaces. Tape to underside of countertop at a minimum of 48 inches o.c. Remove protection at Substantial Completion.

END OF SECTION

SECTION 12 35 53 - LABORATORY CASEWORK

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes wood laboratory cabinets, with epoxy resin countertops, assembled from stock components.
- B. Related Sections:
 - 1. Section 06 10 53 - Miscellaneous Rough Carpentry: Grounds and support framing.

1.2 REFERENCES

- A. Architectural Woodwork Institute:
 - 1. AWI - Quality Standards Illustrated.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Indicate materials, component profiles and elevations, assembly methods, joint details, fastening methods, accessory listings, hardware location and schedule of finishes.
- C. Product Data: Submit data for each type of casework unit and hardware accessory.
- D. Samples:
 - 1. Submit two samples, 6 x 6 inches in size, of cabinet body and countertop materials, illustrating color and finish.
 - 2. Submit one full size sample of a typical base cabinet unit, complete with doors, drawers, and hardware, but without countertop.
 - 3. Submit one full size sample of a typical wall cabinet unit, complete with doors, shelves, and hardware.
 - 4. Submit one full size sample of fabricated sink unit, with plumbing fixtures and accessories.
 - 5. Approved samples may be incorporated into the Work. If not incorporated into the Work, retain approved samples in building until completion of the Work and remove when directed by Architect.

1.4 QUALITY ASSURANCE

- A. Perform work in accordance with AWI (Architectural Woodwork Institute) Architectural Woodwork Quality Standards Illustrated, Custom Grade.
- B. Perform work in accordance with SEFA 8, Laboratory Furniture--Casework, Shelving, and Tables--Recommended Practices.
- C. Single Source Responsibility: All casework, countertops, and accessories furnished under this Section shall be supplied by a single manufacturer.

- D. Catalog Standards: Identification of casework units by manufacturer's catalog numbers are intended to establish a basis-of-design for such units, and are not intended to preclude the substitution of equivalent products by other manufacturers.

1.5 QUALIFICATIONS

- A. Fabricator: Company specializing in performing Work of this section with minimum three years experience.

1.6 PRE-INSTALLATION MEETINGS

- A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
- B. Protect units from moisture damage.

1.8 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 - Product Requirements.
- B. During and after installation of Work of this section, maintain same temperature and humidity conditions in building spaces as will occur after occupancy.

1.9 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

PART 2 - PRODUCTS

2.1 WOOD LABORATORY CASEWORK

- A. Manufacturers:
 - 1. ICI CampbellRhea www.iciscientific.com
 - 2. Indeco Sales, Inc.; www.macomfg.com
 - 3. Leonard Peterson & Co.; www.lpco.com
 - 4. Sheldon Lab Systems; www.sheldonlabs.com
 - 5. Substitutions: Section 01 60 00 - Product Requirements.
- B. Definitions: The following definitions apply to wood laboratory casework:
 - 1. Exposed portions of casework (Finish Surfaces) include surfaces visible when doors and drawers are closed. Bottoms of cases more than 4'-0" above floor, tops of cases less than 6'-6" above floor, and visible members in open cases or behind glass doors shall be considered exposed.

2. Semi-exposed portions of casework includes those members behind opaque doors, such as shelves, divisions, interior faces of ends, case back, drawer sides, backs and bottoms, and back face of doors. Tops of cases 6'-6" or more above floor shall be considered semi-exposed.
3. Concealed portions of casework include sleepers, web frames, dust panels, and other surfaces not usually visible after installation.

2.2 COMPONENTS

- A. Exposed Materials: Do not use exposed faces of lighter-than-average color joined with exposed faces of darker-than-average color. Do not use two adjacent faces which are noticeably dissimilar in grain, figure, and natural character markings.
 1. Solid Lumber: Clear, dry, premium grade red oak, free from defects and selected for compatible grain and color.
 2. Plywood Face Veneer: Same species as exposed solid lumber, clear, selected for grain and color compatible with exposed solid lumber, no defects. Provide solid crossbandings without voids. Edgeband exposed edges with solid wood of same species as face veneer.
- B. Semi-Exposed Materials:
 1. Solid Lumber: Dry, sound, selected to eliminate appearance defects. Any species of hardwood, or softwood of similar color and grain to exposed portions.
 2. Plywood: Hardwood, ANSI/HPMA HP, Good Grade, or softwood ANSI/VOL. PROD. STD. PS-1, Group 1, A-A, INT, of species to match color and grain of exposed members.
- C. Concealed Members:
 1. Solid Lumber or Plywood: Any species, with no defects affecting strength or utility.
 2. Particleboard: ANSI A208.1, minimum 40 lb./cu. ft. density, Grade 1-M-2 or better.
 3. Hardboard: ANSI/AHA A135.4, Class 1, tempered.

2.3 ACCESSORIES

- A. Glass: Clear tempered double strength, as specified in Section 08 80 00 .
- B. Fasteners and Anchors:
 1. Fasteners: Hot dipped or Electro galvanized steel for high humidity and treated wood locations, unfinished steel elsewhere.
 2. Nails and Staples: ASTM F1667.
- C. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application.
- D. Concealed Joint Fasteners: Threaded steel.
- E. Grommets: Metal material for cut-outs.
- F. Hardware: Manufacturer's standard commercial-quality, heavy-duty hardware complying with requirements indicated, constructed with base materials and finishes as selected from manufacturer's full range of standard materials and finishes.

1. Butt Hinges: Semiconcealed, 5-knuckle hinges complying with BHMA A156.9, Grade 1, constructed from minimum 0.095-inch tempered steel, with antifriction bearings and rounded tips. Provide minimum 170° door swing. Provide 2 hinges for doors less than 48 inches high and 3 hinges for doors 48 inches or more high.
2. Pulls: Solid metal, for drawers and swing doors, mounted with 2 screws fastened from back. For sliding doors, provide recessed flush pulls. Provide 2 pulls for drawers over 24" wide.
3. Door Catches: Dual self-aligning permanent magnet type. Provide 2 catches on doors over 4 ft. high.
4. Drawer Slides:
 - a. Light and Medium Duty Drawers: Accuride 3832, KV 8400 or approved equivalent. Full extension all ball bearing 100 lbs. load rated with lever disconnect and positive outstop preventing inadvertent drawer removal.
Or:
 - b. 100 pound load rated epoxy powder coated steel, bottom corner mounted with smooth, quiet nylon rollers. Positive stop in both directions and self-closing feature.
5. File Drawer and Wide Heavy Duty Drawers:
 - a. Accuride 4032, KV 8400 or approved equivalent. Full extension all ball bearing 150 lbs. load rated with rail mount, hold-in detent, progressive movement and positive outstop preventing inadvertent drawer removal.
Or:
 - b. 150 pound load rated epoxy powder coated steel, bottom corner mounted with smooth, quiet nylon rollers. Positive stop in both directions and self-closing feature.
6. Label Holders: Provide where indicated, size to receive standard label cards approximately 1" x 2" nominal size, finished to match other exposed hardware.
7. Drawer and Cupboard Locks: As specified in Section 08 71 00.
8. Sliding Door Hardware Sets: Manufacturer's standard, to suit type and size of sliding door units.
9. Cabinet Base: Extruded rubber, color as indicated on the color schedule for rubber base, 4" high. Provide on exposed sides, fronts, and backs of floor-mounted cabinets.
10. Leg Shoes: Extruded vinyl or rubber, black, open bottom type.
11. Adjustable Shelf Supports: BHMA B84073, wrought steel, mortise mounted into cabinet end panels and vertical dividers, adjustable on approximately 1.375 inch centers. Each shelf support to have two integral support pins, 5mm minimum diameter, to interface predrilled holes and to prevent rotation of support. Provide four supports per shelf. The support automatically adapts to 3/4 inch or 1 inch thick shelving and provides non-tip feature for shelving. Supports shall be designed so that they may be field fixed if desired. Structural load to 1200 pounds without failure (300 pounds per support).

2.4 FABRICATION

- A. Shop assemble casework for delivery to site in units easily handled and to permit passage through building openings.
- B. Door and Drawer Fronts: 3/4 inch thick; flush overlay style.
- C. When necessary to cut and fit on site, fabricate materials with ample allowance for cutting. Furnish trim for scribing and site cutting.
- D. Fabricate cabinets and counter tops with cutouts for plumbing fixtures, inserts, appliances, outlet boxes, and other fixtures and fittings. Verify locations of cutouts from on-site dimensions.
- E. Shop glaze glass materials using Interior Dry method specified in Section 08 80 00 .

F. Epoxy Resin Countertops:

1. Size: Maximum practicable lengths.
2. Thickness: Maintain 1 inch thickness with tolerance not exceeding plus or minus 1/32 inch. Provide front and end overhang of 1 inch over base cabinets, formed with continuous drip groove on under surface 1/2 inch from edge.
3. Cast Epoxy Resin: Factory molded tops of modified epoxy resin formulation, uniform mixture throughout full thickness. Color, non-glaring black.
 - a. Physical Properties: Flexural strength - 4000 psi; compressive strength - 14,000 psi; hardness, Rockwell M - 197; water absorption in 24 hours - 0.05 percent; heat distortion point -400 deg. F; highly resistant to thermal shock.
 - b. Chemical Resistance: Spot test of following reagents in standard laboratory concentrations, in contact with finished top for 24 hours; top shall be entirely unaffected or show only slight dulling of finish:
 - 1) glacial acetic acid.
 - 2) hydrochloric acid.
 - 3) nitric acid.
 - 4) phosphoric acid.
 - 5) sulphuric acid.
 - 6) chromic acid.
 - 7) ammonium hydroxide.
 - 8) calcium hypochlorite.
 - 9) sodium hydroxide.
 - 10) acetone.
 - 11) amyl acetate.
 - 12) aqua regia.
 - 13) benzene.
 - 14) butyl alcohol.
 - 15) ethyl acetate.
 - 16) ethyl alcohol.
 - 17) ethyl ether.
 - 18) formaldehyde.
 - 19) hydrogen peroxide.
 - 20) methyl alcohol.
 - 21) methyl ethyl ketone.
 - 22) kerosene.
 - 23) phenol.
 - 24) silver nitrate.
 - 25) trichloroethylene.
 - 26) xylene.
 - 27) zinc chloride
 - c. Workmanship: Cast surfaces very smooth, with factory cut-outs for sinks and drip grooves. Plain butt type joints assembled with epoxy adhesive and prefitted, concealed metal spline.

G. Sinks:

1. Sizes: As indicated or manufacturer's closest stock size of equal or greater volume, as acceptable to Architect.
2. Outlets: 1-1/2 inch diameter, 6 inch minimum length, fabricated of silicon iron, cast epoxy resin, stainless steel, glass, or lead; of same material as sink wherever possible, or as otherwise acceptable to Architect.
3. Overflows: For each sink, except cup sinks, provide overflow of standard beehive or open top design and with separate strainer. Height 2 inches less than sink depth. Provide in same material as sink.

4. Cast Epoxy Resin Sinks: Nonglare black, molded in one piece with surfaces smooth, corners coved and bottom sloped to outlet. Minimum physical properties and chemical resistance as specified for cast epoxy resin tops. Thickness, 1/2 inch minimum.
5. Reagent Racks: Single-face or double faced units as required, fabricated of manufacturer's standard design to suit type and composition of top units.
6. Upright Rod Assembly and Metal Crossbar: Aluminum or stainless steel. Two vertical rods and one horizontal cross bar, 3/4 inch diameter and 36 inches long, unless otherwise shown, two flush socket receptacles and two cross bar clamps. Taper ends of vertical rods to fit flush plates; all other rod ends rounded.
7. Burette Rods: Aluminum or stainless steel rods, 1/2 inch diameter and 18 inches long, threaded on one end to suit tapered plug.
8. Greenlaw Arm Assembly: Aluminum or stainless steel vertical rod, tapered one end to suit flush socket receptacle. Adjustable cross bar of hardwood with black acid-resistant finish, secured to upright with adjustable clamp.

H. Mechanical Service Fixtures:

1. Provide units complete with washers, locknuts, unions, nipples and other accessories for positive mounting to supporting laboratory units. Include wall and deck flanges, escutcheons, handle extension rods, remote valves, and similar items required. Fabricate units to withstand test pressure of 100 psig.
2. Material and Finish: Fabricate service fixtures from cast or forged red brass containing a minimum of 85 percent copper. Exposed surfaces including fittings and escutcheons, polished chrome plated finish.
 - a. For fixtures inside fume hoods, coat with acid and solvent resistant baked-on plastic coating. Color, manufacturer's standard metallic brown, aluminum, or as otherwise acceptable to Architect.
3. Service Outlets Identification: Provide colored plastic index discs with embossed identification letters at each service fixture handle or knob. Secure discs to fixture handles to be virtually tamperproof.
4. Ground Key Type Hose Cocks: Tapered core and handle of one piece forged brass, ground and lapped, held in place under constant spring pressure.
5. Handles: Provide 3-arm or 4-arm forged brass handles for valves, stops, faucets, remote controls, and cocks, except for ground key cocks, steam valves, and micro-adjustable needle cocks.
6. Needle Valves: Provide units with renewable self-centering floating cones and renewable seats of stainless steel or monel metal.
7. Water Valves or Faucets: Provide units with renewable barrel locked in valve body. Barrel shall contain all wearing parts, with renewable discs.
8. Remote Control Valves: Although straight through type are indicated, use angle valves where ever required.
9. Vacuum Breakers: Provide vacuum breakers on all water fixtures (hot or cold) equipped with serrated outlets.

I. Electrical Service Fixtures:

1. Service Fixtures: Provide units complete with metal housing or box; necessary receptacles, terminals, switches, pilot lights, device plates; and fittings and gaskets required for mounting on casework. All fixtures UL labeled.
2. Recessed Type Fixtures: Galvanized steel outlet box, size as required complete with cover plate and receptacles or other devices as indicated.
3. Cover Plates: Provide stainless steel cover plates for AC outlets and devices, and laminated plastic plates for DC or combination AC/DC outlets and devices.
 - a. Stainless steel, Type 302, satin finish, with formed beveled edges.

4. Cover Plate Identification: Identify cover plates at receptacles, switches, terminal posts and other locations as indicated. Provide 1/4 inch high letters unless otherwise indicated.
5. In addition, identify the following devices whether indicated on drawings or not.
 - a. AC receptacles, other than standard 125 volt duplex, grounding type. Indicate voltage and phase.
 - b. Switches and thermal overload switches. Indicate equipment being controlled (e.g. "FUME HOOD FAN").
 - c. Pilot lights when located remotely from associated equipment or switch, where function is not obvious. Indicate equipment or circuit being energized.
6. On stainless steel, either etch directly on plate or apply laminated plastic nameplates. Fill etched letters on cover plates with black enamel. Etch laminated plastic strips to provide white lettering on black background and securely fasten to cover plate with non-corrosive fasteners or epoxy adhesive.
7. Receptacles: Furnish AC receptacles for AC circuits. Unless otherwise indicated, provide ivory or brown colored units as selected by Architect.
8. Switches: Furnish single pole, double pole, or 3-way switches, as required, rated 120-277 volts AC, and in amperage capacities to suit units served. Furnish in color to match receptacles.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Verify adequacy of backing and support framing.
- C. Verify location and sizes of utility rough-in associated with work of this section.

3.2 INSTALLATION

- A. Set and secure casework in place; rigid, plumb, and level.
- B. Use concealed joint fasteners to align and secure adjoining cabinet units, counter tops, and splashes.
- C. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim for this purpose.
- D. Base Cabinets:
 1. Fasten each individual cabinet to floor at toe space, with fasteners spaced 24 inches o.c. Bolt continuous cabinets together. Secure individual cabinets with not less than 2 fasteners into floor, where they do not adjoin other cabinets.
 2. Where required, assemble units into one integral unit with joints flush, tight, and uniform. Align similar adjoining doors and drawers to a tolerance of 1/16 inch.
- E. Wall Cabinets:
 1. Securely fasten to solid supporting material, not plaster, lath, or wallboard. Anchor, adjust, and align wall cabinets as specified for base cabinets.

2. Reinforcement of stud walls to support wall-mounted cabinets will be performed during wall erection by trade involved, but responsibility for accurate location and sizing of reinforcement is part of this Work.
- F. Install panels covering all plumbing, hvac, and electrical work. Panels shall match exposed casework construction. Panels shall have access doors with piano hinges and masterkeyed lock cylinder with recessed door panel infilled with material to match exposed panel.
- G. Adjust casework and hardware so that doors and drawers operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.
- H. Countertops:
 1. Field Jointing: Where practicable, make in same manner as factory jointing using dowels, splines, adhesives, and fasteners recommended by manufacturer. Locate field joints as shown on accepted shop drawings, factory prepared so there is no job site processing of top and edge surfaces.
 2. Fastenings: Secure epoxy resin countertops to cabinets with epoxy cement applied at each corner and along perimeter edges at not more than 48 inches oc.
 3. Workmanship: Abut top and edge surfaces in one true plane, with internal supports placed to prevent any deflection. Provide flush hairline joints in top units using clamping devices.
 4. After installation, carefully dress joints smooth, remove any surface scratches, clean and polish entire surface.
 5. Provide holes and cutouts as required for mechanical and electrical service fixtures.
 6. Provide scribe moldings for closures at junctures of top, curb and splash with walls as recommended by manufacturer for materials involved. Use permanently elastic sealing compound recommended by manufacturer.
 7. Seal space between countertop backsplash and wall with sealant specified in Section 07 90 00 .
- I. Accessories: Install in accordance with manufacturer's directions. Turn screws to a flat seat; do not drive. Adjust moving parts to operate freely without excessive bind.

3.3 ADJUSTING

- A. Section 01 70 00 - Execution and Closeout Requirements: Testing, adjusting and balancing.
- B. Adjust moving or operating parts to function smoothly and correctly.

3.4 CLEANING

- A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.
- B. Clean casework, counters, shelves, hardware, fittings, and fixtures.

END OF SECTION

SECTION 12 36 00 - COUNTERTOPS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Countertops for architectural cabinetwork.
- B. Countertops for manufactured casework.

1.2 RELATED REQUIREMENTS

- A. Section 06 41 00 - Architectural Wood Casework.

1.3 SUBMITTALS

- A. Product Data: Manufacturer's data sheets on solid surface material.
 - 1. Preparation instructions and recommendations.
- B. Shop Drawings: Complete details of materials and installation of each type of countertop; combine with shop drawings of cabinets and casework specified in other sections.
- C. Verification Samples: For each finish product specified, minimum size 6 inches square, representing actual product, color, and patterns.
- D. Test Reports: Chemical resistance testing, showing compliance with specified requirements.
- E. Installation Instructions: Manufacturer's installation instructions and recommendations.
- F. Maintenance Data: Manufacturer's instructions and recommendations for maintenance and repair of countertop surfaces.

1.4 QUALITY ASSURANCE

- A. Fabricator Qualifications: Same fabricator as for cabinets on which tops are to be installed.
- B. Installer Qualifications: Fabricator.

1.5 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.

1.6 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.

PART 2 - PRODUCTS

2.1 COUNTERTOP ASSEMBLIES

- A. Quality Standard: See Section 06 41 00.
- B. Plastic Laminate Countertops: Refer to Section 06 41 00.
- C. Quartz Countertops: Quartz slabs bonded to substrate; use as large pieces as possible with inconspicuous adhesive joints.
 - 1. Stone: Quartz with epoxy resins without cracks, voids, or pin holes .
 - 2. Color: As scheduled
 - 3. Manufacturer's Name: Silestone; or equal. .
 - 4. Stone Thickness: 1/2 inch, minimum.
 - 5. Surface Finish: As scheduled.
 - 6. Exposed Edge Treatment: Provide 1/2" min. vertical radius at tops, and 1-1/2" min radius at all corners.
 - 7. Back and End Splashes: Same material, same thickness; for field attachment.

2.2 ACCESSORY MATERIALS

- A. Plywood for Supporting Substrate: PS 1 Exterior Grade, A-C veneer grade, minimum 5-ply; minimum 3/4 inch thick; join lengths using metal splines.
- B. Adhesives: Chemical resistant waterproof adhesive as recommended by manufacturer of materials being joined.
- C. Cove Molding for Top of Splashes: Rubber with semi-gloss finish and T-spline to fit between splash and wall; 1/2 inch by 1/2 inch ; color as selected.
- D. Joint Sealant: Mildew-resistant silicone sealant, white.

2.3 FABRICATION

- A. Fabricate in accordance with standards governing fabrication quality that are specified in Section 06 41 00.
- B. 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 except where top butts against cabinet or wall.
 - 3. Prepare all cutouts accurately to size; replace tops having improperly dimensioned or unnecessary cutouts or fixture holes.
 - 4. Provide 1-1/2" min. radius on all exposed counter top corners.
- C. Provide back/end splash wherever counter edge abuts vertical surface unless otherwise indicated.
 - 1. Secure to countertop with concealed fasteners and with contact surfaces set in waterproof glue.
 - 2. Height: 4 inches, unless otherwise indicated.

- D. Solid Surfacing: Fabricate tops up to 144 inches long in one piece; join pieces with adhesive sealant in accordance with manufacturer's recommendations and instructions. Do not provide solid substrate under solid surface material; use ladder type support substrate as instructed by solid surface manufacturer.
- E. Wall-Mounted Counters: Provide skirts, aprons, brackets, and braces as indicated on drawings, finished to match as indicated on Drawings.

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. Securely attach countertops to cabinets using concealed fasteners. Make flat surfaces level; shim where required.
- B. 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 PROTECTION

- A. Clean countertops surfaces thoroughly.
- B. Protect installed products until completion of project.
- C. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 12 56 51 - LIBRARY FURNITURE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Free-standing library furniture consisting of the following:
 - a. Shelves.
 - b. Book carts.

B. Related Sections:

1. Section 10 56 13 - Metal Storage Shelving; four-post metal storage shelving.

1.2 SUBMITTALS:

A. Product Data: Submit manufacturer's product literature for each type of library furniture item and installation accessory required.

1. Submit written data on physical characteristics, load bearing capabilities and durability.

B. Maintenance Data: Include data in Maintenance Manual as specified in Division-1.

C. Maintenance Instructions: Submit manufacturer's printed instructions for maintenance of installed work, including methods and frequency recommended for maintaining optimum condition of wood and painted metal surfaces under anticipated use conditions. Include precautions against materials and methods which may be detrimental to finishes and performance.

D. Shop Drawings: Submit installation drawings showing location extent of library furniture. Samples for Verification: Submit 12" square samples of each wood and paint finish required, prepared from same material to be used for the work.

1.3 QUALITY ASSURANCE:

A. Manufacturer's Qualifications: Firm (material producer) with not less than 3 years of production experience, whose published literature clearly indicates general compliance of products with requirements of this section.

B. Installer's Qualifications: Firm specializing in furniture installation with not less than 2 years of experience in installation similar to those required for this project.

C. Single Source Responsibility: Provide material produced by a single manufacturer for all free-standing library furniture.

1.4 DELIVERY, STORAGE AND HANDLING:

- A. Deliver materials to project site in original factory wrappings and containers, clearly labeled with identification of manufacturer, brand name, and lot number. Store materials in original undamaged packages and containers, inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, humidity; laid flat, blocked off ground to prevent sagging and warping.
- B. Comply with instructions and recommendations of manufacturer for special delivery, storage, and handling requirements.

1.5 SEQUENCING AND SCHEDULING:

- A. Sequence library furniture installation with other work to minimize possibility of damage and soiling during remainder of construction period.

1.6 WARRANTY:

- A. Special Project Warranty: Submit a written warranty, executed by the Contractor, Installer and the Manufacturer, agreeing to repair or replace units which fail in materials or workmanship within the specified warranty period.
 - 1. This warranty shall be in addition to and not a limitation of other rights the Owner may have against the Contractor under the Contract Documents.
 - a. Warranty period is 2 years after the date of substantial completion.

1.7 MAINTENANCE:

- A. Replacement Materials: Furnish accessory components as required. Furnish replacement materials from same production run as materials installed. Package replacement materials with protective covering, identified with appropriate labels.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

- A. Basis-of-Design: Subject to compliance with requirements, provide Russwood Library Furniture manufactured by Russell Carol Manufacturing, Inc., www.russwood.com, or comparable products by one of the following:
 - 1. Buckstaff Company www.buckstaff.com
 - 2. Tesco Industries www.tesco-ind.com.
 - 3. Worden Co. www.wordencompany.com
 - 4. Brodart Company www.brodart.com

2.2 MATERIALS:

- A. Solid Wood: Red Oak, free from imperfections, thoroughly air seasoned, kiln dried to moisture content of 5-7%.

- B. Plywood Core Stock: Constructed with odd number of plies, all interior plies except core of center ply, occurring in pairs. Plies of each interior pair of same species, thickness and grain direction, placed on opposite sides of core. Grain direction of each ply at right angles to grain of adjacent plies, and edges of panels. All plies free of blisters, wrinkles, laps or other defects.
- C. Glue: Water-resistant resin adhesive which retains strength when subjected to thorough wetting and drying.
- D. Exposed Veneers: Plain-sliced, AWI standard A grade, uniform even grain.

2.3 MANUFACTURED UNITS:

- A. Provide library furniture items with the following details, in sizes, quantities and configurations as scheduled.
 - 1. Tops: Minimum 1 inch thick, 5-ply Veneer Core Plywood construction, with 1 x 3 inch solid hardwood banding, face veneer on exposed surface, plain veneer on underside.
 - 2. End Panels and Back Panel: Same construction as worksurface top; height and width for sizes scheduled.
 - 3. Shelves: Adjustable sheet metal, 18 gage thick, with box-formed edges and shelf pins set into 5/16 inch holes in end panels.
 - 4. Kickbase/Toeboard: Solid lumber to match top and end panels.

2.4 FINISHES:

- A. Wood Finishes: Provide library furniture with manufacturer's stain and clear wood finish as specified below:
 - 1. Stain color as selected by Architect from manufacturer's standard finishes.
- B. Metal Finishes: Manufacturer's baked enamel paint finish, color to be selected by Architect from manufacturer's standard colors.

PART 3 - EXECUTION

3.1 PREPARATION:

- A. Verify that all library furniture components, including size and finish, are those specified before installing.

3.2 INSTALLATION:

- A. Install furniture and accessories after finishing operations, including painting, have been completed.
- B. Install furniture to comply with final layout drawings in strict compliance with manufacturer's printed instructions. Position units level, plumb; at proper location relative to adjoining units and related work. Adjust accessories to provide visually acceptable installation.

3.3 FIELD QUALITY CONTROL:

- A. Remove and replace components which are chipped, scratched or otherwise damaged, or do not operate smoothly and which do not match adjoining work. Provide new matching units, installed as specified and in manner to eliminate evidence of replacement.

3.4 CLEANING:

- A. Immediately upon completion of furniture installation, clean components and surfaces.
- B. Remove surplus materials, rubbish and debris resulting from installation, upon completion of work and leave areas of installation in neat clean condition.

3.5 PROTECTION:

- A. Protect furniture against damage during remainder of construction period. Advise Owner of additional protection needed to ensure that furniture will be without damage or deterioration at time of substantial completion.

END OF SECTION

SECTION 13 34 16 - PRE-ENGINEERED GRANDSTANDS AND BLEACHERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Fixed aluminum bleachers.

1.2 SYSTEM PERFORMANCE REQUIREMENTS

- A. Structural Performance: Design, engineer, fabricate, and install bleachers to withstand the following structural loads without exceeding the allowable design working stresses of the materials involved, including anchors and connections. Apply each load to produce the maximum stress in each respective component of each bleacher unit.
 - 1. Conform to current version of IBC and ICC 300 - Bleachers, Folding and Telescopic Seating, and Grandstands.
 - 2. Design Loads:
 - a. Live Loads:
 - 1) Uniform Loading, Structure: 100 psf.
 - 2) Uniform Loading, Seats: 120 plf.
 - b. Sway Loads:
 - 1) Perpendicular to Seats: 10 plf.
 - 2) Parallel to Seats: 24 plf.
- B. Design handrail, guardrail, and attachments to resist forces as required by applicable code. Apply loads non-simultaneously to produce maximum stresses.
 - 1. Guard Top Rail and Handrail Concentrated Load: 200 pounds applied at any point in any direction.
 - 2. Guard Top Rail Uniform Load: 50 plf applied in any direction.
 - 3. Intermediate Rails, Panels, and Baluster Concentrated Load: 50 pounds applied to 1 sf area.
- C. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.
- D. Thermal Movements: Allow for thermal movement resulting from the following maximum change (range) in ambient temperature in the design, fabrication, and installation of handrails and railings to prevent buckling, opening up of joints, and overstressing of components, connections, and other detrimental effects. Base design calculation on actual surface temperatures of materials due to both solar heat gain and nighttime sky heat loss.
 - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
- E. Lateral Deflection: Where masonry, plaster, gypsum board, or other similar building elements are directly or indirectly laterally supported by the bleacher structure, limit lateral deflection to 1/600 of the span.
- F. Conform to Texas Accessibility Requirements for ramp, platform, and handrail construction.

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Product data for each type of bleacher and accessory indicated including manufacturer's installation and maintenance procedures.
- C. Shop drawings indicating layout of bleachers and platforms coordinated with field measurements, installation diagrams, seat heights, row spacing and rise, aisle widths and locations, overall dimensions, connections and relationship to adjoining work, accessories, types of materials, and finishes.
 - 1. Submit a complete structural analysis that has been signed and sealed by a qualified professional engineer responsible for their preparation.
- D. Samples for verification purposes of the following items, prepared on samples of size indicated below and of same thickness and material as indicated for final unit of Work:
 - 1. Aluminum Products: 12-inch sample of each aluminum product and accessory including seatboards, platforms, handrails, and brackets.
- E. Maintenance data for inclusion in Operating and Maintenance Manual specified in Division 1 including detailed instructions indicating proper means for maintaining each type of bleacher and accessory required.
- F. Qualification data for firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include list of completed projects with project names, addresses, names of Architects and Owners, and other information specified.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced Installer to perform unit of work of this section who has specialized in the installation of types of bleachers similar to that required for this project and who is acceptable to, or certified by, manufacturer of bleachers.
- B. Engineer Qualifications: Professional engineer licensed to practice in jurisdiction where project is located and experienced in providing engineering services of the kind indicated that have resulted in the successful installation of bleachers similar in material, design, and extent to those indicated for this Project.
- C. Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code - Steel" and D1.3 "Structural Welding Code - Sheet Steel."

1.5 PROJECT CONDITIONS

- A. Field Measurements: Check actual dimensions of construction affecting bleachers by accurate field measurements before fabrication; show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delay of Work.
- B. Where field measurements cannot be made without delaying the Work, guarantee dimensions and proceed with fabrication of bleachers without field measurements. Coordinate construction to ensure that actual dimensions correspond to guaranteed dimensions.

1.6 PROJECT CONDITIONS

- A. Field Measurements: Check actual dimensions of construction affecting grandstands and bleachers by accurate field measurements before fabrication; show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delay of Work.
- B. Where field measurements cannot be made without delaying the Work, guarantee dimensions and proceed with fabrication of grandstands and bleachers without field measurements. Coordinate construction to ensure that actual dimensions correspond to guaranteed dimensions.

1.7 DELIVERY, STORAGE AND HANDLING:

- A. Schedule: Schedule delivery date and notify those responsible for unloading materials.
- B. Storage: Manufacturer's representative shall notify the Contractor of all requirements for the proper storage of materials in advance of delivery.
- C. Handling: Manufacturer's representative shall be present at time of delivery to instruct and supervise the unloading and storage of materials.

PART 2 - PRODUCTS

2.1 FIXED ALUMINUM BLEACHERS AND PLATFORMS:

- A. Manufacturers:
 - 1. Dant Corporation. www.dantclayton.com .
 - 2. Southern Bleacher Company www.southernbleacher.com.
 - 3. Sturdisteel www.sturdisteel.com.
 - 4. Substitutions: Section 01 60 00 - Product Requirements.
- B. Basis-of-Design: The design, fabrication and construction is based on grandstands and bleachers as manufactured by Southern Bleacher Company, Inc., Graham, Texas.

2.2 MATERIALS

- A. Metal Surfaces, General: For metal fabrications exposed to view upon completion of the Work, provide materials selected for their surface flatness, smoothness, and freedom from surface blemishes. Do not use materials whose exposed surfaces exhibit pitting, seam marks, roller marks, rolled trade names, roughness, and, for steel sheet, variations in flatness exceeding those permitted by reference standards for stretcher-leveled sheet.
- B. Steel: Hot-dip galvanized after fabrication.
- C. Aluminum: Alloy and temper recommended in writing by manufacturer for type of use and finish indicated.
- D. Brackets, Flanges and Anchors: Cast or formed metal of the same type material and finish as supported metal, unless otherwise indicated.

- E. Concrete Inserts: Threaded or wedge type; galvanized ferrous castings, either malleable iron, ASTM A 47, or cast steel, ASTM A 27. Provide bolts, washers, and shims as required, hot-dip galvanized per ASTM A 153.
- F. Welding Rods and Bare Electrodes: Select in accordance with AWS specifications for the metal alloy to be welded.
- G. Nonshrink Nonmetallic Grout: Premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with CE CRD-C 621. Provide grout specifically recommended by manufacturer for interior and exterior applications of type specified in this section.
- H. Fasteners: Aluminum, hot-dip galvanized steel, or stainless steel. Use fasteners of the same basic metal as fastened metal unless otherwise indicated. Use metals that are noncorrosive and compatible with each metal joined.
 - 1. Use concealed fasteners for interconnecting metal components and for attaching them to other work unless exposed fasteners are unavoidable.
 - 2. For exposed fasteners, use tamper-resistant screws of head profile flush with metal surface unless otherwise indicated.
 - 3. Finish heads of exposed fasteners to match finish of metal fastened unless otherwise indicated.
 - 4. Do not use power-actuated fasteners for concrete substrates.

2.3 FINISHES:

- A. Aluminum:
 - 1. Clear anodized finish for seatboards, risers, and railings.
 - 2. Mill finish for footboards.

2.4 CONSTRUCTION

- A. Materials:
 - 1. Understructure: Galvanized steel angle frames spaced at maximum 6 foot intervals and connected by cross braces.
 - 2. Rise per Row: 8 inches.
 - 3. Depth per Row: 24 inches.
 - 4. Seatboards: 2" x 10" aluminum extrusion with end caps, 17 inches high.
 - 5. Footboards: 2" x 10" and 2" x 12" aluminum extrusion with end caps.
 - 6. Risers: 1" wide aluminum extrusions.
 - 7. Bracket: Manufacturer's "L" bracket.
 - 8. Handrails and Guardrails: 1 1/2" OD aluminum tube. Guardrails at all locations shall have members that will not allow a 4" diameter sphere to pass through.
 - 9. Wheelchair Area: 5'-6" wide for two wheelchairs, 3'-0" wide for single wheelchair.

PART 3 - .EXECUTION

3.1 ERECTION

- A. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with a heavy coat of bituminous paint or zinc chromate primer.

- B. Erection and installation shall be by the manufacturer of the bleachers or their authorized agents.
- C. Inspect other work and verify that it is acceptable before commencing with this work.
- D. In the event of discrepancy, notify the Architect.

3.2 CLEANING

- A. Remove all excess materials at completion of work, carefully inspect installation and make necessary adjustments to insure proper conditions for a completed structure.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensures that bleachers are without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 13 34 19 - METAL BUILDING SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Structural steel framing.
2. Metal roof panels.
3. Metal wall panels.
4. Metal soffit panels.
5. Metal building insulation.
6. Accessories.

B. Related Requirements:

1. Section 03 30 00 "Cast-in-Place Concrete" for slabs and foundations.
2. Section 05 50 00 "Metal Fabrications" for miscellaneous steel framing and fabrications supporting materials of other Sections.
3. Section 08 11 13 "Hollow Metal Doors and Frames" for hollow metal frames installed in metal building systems.
4. Section 08 33 23 "Overhead Coiling Doors" for overhead coiling doors installed in metal building systems.

1.2 DEFINITIONS

- ##### A. Terminology Standard: See MBMA's "Metal Building Systems Manual" for definitions of terms for metal building system construction not otherwise defined in this Section or in standards referenced by this Section.

1.3 COORDINATION

- ##### A. Coordinate sizes and locations of concrete foundations and casting of anchor-rod inserts into foundation walls and footings. Anchor rod installation, concrete, reinforcement, and formwork requirements are specified in Section 03 30 00 "Cast-in-Place Concrete."
- ##### B. Coordinate installation of metal roof and wall panel assemblies, rain drainage work, flashing, trim, supports, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.4 PREINSTALLATION MEETINGS

- ##### A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to metal building systems including, but not limited to, the following:
 - a. Condition of foundations and other preparatory work performed by other trades.
 - b. Structural load limitations.
 - c. Construction schedule. Verify availability of materials and erector's personnel, equipment, and facilities needed to make progress and avoid delays.
 - d. Required tests, inspections, and certifications.

- e. Unfavorable weather and forecasted weather conditions and impact on construction schedule.
2. Review methods and procedures related to metal roof panel assemblies including, but not limited to, the following:
 - a. Compliance with requirements for purlin and rafter conditions, including flatness and attachment to structural members.
 - b. Structural limitations of purlins and rafters during and after roofing.
 - c. Flashings, special roof details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect metal roof panels.
 - d. Temporary protection requirements for metal roof panel assembly during and after installation.
 - e. Roof observation and repair after metal roof panel installation.
3. Review methods and procedures related to metal wall and soffit panel assemblies including, but not limited to, the following:
 - a. Compliance with requirements for support conditions, including alignment between and attachment to structural members.
 - b. Structural limitations of girts and columns during and after wall panel installation.
 - c. Flashings, special siding details, wall penetrations, openings, and condition of other construction that will affect metal wall panels.
 - d. Temporary protection requirements for metal wall panel assembly during and after installation.
 - e. Wall observation and repair after metal wall panel installation.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of metal building system component.
 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
 - a. Metal roof panels.
 - b. Metal wall panels.
 - c. Metal soffit panels.
 - d. Thermal insulation and air barrier facings.
- B. Shop Drawings: Indicate components by others. Include full building plan, elevations, sections, details and the following:
 1. Anchor-Rod Plans: Submit anchor-rod plans and templates before foundation work begins. Include location, diameter, and minimum required projection of anchor rods required to attach metal building to foundation. Indicate column reactions at each location.
 2. Structural-Framing Drawings: Show complete fabrication of primary and secondary framing; include provisions for openings. Indicate welds and bolted connections, distinguishing between shop and field applications. Include transverse cross-sections.
 3. Metal Roof and Wall Panel Layout Drawings: Show layouts of panels including methods of support. Include details of edge conditions, joints, panel profiles, corners, anchorages, clip spacing, trim, flashings, closures, and special details. Distinguish between factory- and field-assembled work; show locations of exposed fasteners.
 - a. Show roof-mounted items and penetrations.
 - b. Show wall-mounted items including personnel doors, vehicular doors, windows, louvers, and lighting fixtures.
 4. Accessory Drawings: Include details of the following items, at a scale of not less than 1-1/2 inches per 12 inches:

- a. Flashing and trim.
- b. Gutters.
- c. Downspouts.

C. Samples for Verification: For the following products:

1. Panels: Nominal 12 inches long by actual panel width. Include fasteners, closures, and other exposed panel accessories.
2. Flashing and Trim: Nominal 12 inches long. Include fasteners and other exposed accessories.
3. Vapor Retarder Facings: Nominal 6-inch- square Samples.
4. Accessories: Nominal 12-inch- long Samples for each type of accessory.

D. Delegated-Design Submittal: For metal building systems.

1. Include analysis data indicating compliance with performance requirements and design data signed and sealed by the qualified professional engineer responsible for their preparation.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and erector.

B. Welding certificates.

C. Letter of Design Certification: Signed and sealed by a qualified professional engineer. Include the following:

1. Name and location of Project.
2. Order number.
3. Name of manufacturer.
4. Name of Contractor.
5. Building dimensions including width, length, height, and roof slope.
6. Indicate compliance with AISC standards for hot-rolled steel and AISI standards for cold-rolled steel, including edition dates of each standard.
7. Governing building code and year of edition.
8. Design Loads: Include dead load, roof live load, collateral loads, deflection, wind loads/speeds and exposure, seismic design category, and auxiliary loads (cranes).
9. Load Combinations: Indicate that loads were applied acting simultaneously with concentrated loads, according to governing building code.
10. Building-Use Category: Indicate category of building use and its effect on load importance factors.

D. Erector Certificates: For qualified erector, from manufacturer.

E. Material Test Reports: For each of the following products:

1. Structural steel including chemical and physical properties.
2. Bolts, nuts, and washers including mechanical properties and chemical analysis.
3. Tension-control, high-strength, bolt-nut-washer assemblies.
4. Shop primers.
5. Nonshrink grout.

F. Source quality-control reports.

G. Field quality-control reports.

H. Surveys: Show final elevations and locations of major members. Indicate discrepancies between actual installation and the Contract Documents. Have surveyor who performed surveys certify their accuracy.

I. Sample Warranties: For special warranties.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For metal panel finishes to include in maintenance manuals.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer.

1. Accreditation: Manufacturer's facility accredited according to the International Accreditation Service's AC472, "Accreditation Criteria for Inspection Programs for Manufacturers of Metal Building Systems."
2. Engineering Responsibility: Preparation of comprehensive engineering analysis and Shop Drawings by a professional engineer who is legally qualified to practice in jurisdiction where Project is located.

B. Erector Qualifications: An experienced erector who specializes in erecting and installing work similar in material, design, and extent to that indicated for this Project and who is acceptable to manufacturer.

C. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3, "Structural Welding Code - Sheet Steel."

D. Mockups: Build integrated exterior mockup in accordance with Section 01 40 00 "Quality Requirements" to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Build mockup of typical wall area as shown on Drawings.
2. Mockup shall include all types of metal wall panels, including accessories.
 - a. Size: Minimum 8 x 8 feet.
 - b. Include storefront framing with glazing, minimum 12 inches wide by 16 inches high.
 - c. Include flashing and trim around window and at wall bottom.
 - d. Include thermal insulation, joint treatment, and thermal blocks.
3. Approval of mockup does not constitute approval of deviations from the Contract Documents contained in mockup unless Architect specifically approves such deviations in writing.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, sheets, panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.

B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.

- C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.

1.10 FIELD CONDITIONS

- A. Weather Limitations: Proceed with panel installation only when weather conditions permit metal panels to be installed according to manufacturers' written instructions and warranty requirements.

1.11 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal wall and roof panel assemblies that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including rupturing, cracking, or puncturing.
 - b. Deterioration of metals and other materials beyond normal weathering.
 - 2. Warranty Period: Two years from date of Substantial Completion.
- B. Special Warranty on Metal Panel Finishes: Manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Finish Warranty Period: 20 years from date of Substantial Completion.
- C. Special Weathertightness Warranty for Metal Roof Panels: Manufacturer agrees to repair or replace standing seam metal roof panel assemblies that leak or otherwise fail to remain weathertight within specified warranty period.
 - 1. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Pre-Engineered Metal Building System:
 - 1. Alliance Steel, Inc.
 - 2. American Steel Building, Inc.
 - 3. Butler Manufacturing Company.
 - 4. NCI Building Systems LP.
 - 5. Rigid Structures.
 - 6. Robert S. Henry Company.
 - 7. United Structures of America.
- B. Metal Roof and Wall Panels:

1. Berridge Manufacturing Company.
2. Centria.
3. Fabral.
4. Kingspan Group.
5. MBCI.
6. McElroy Metals.
7. Morin Corporation.
8. Peterson Aluminum Corp.

C. Source Limitations:

1. Obtain metal building framing components, including primary and secondary framing, from single source from single manufacturer.
2. Obtain metal roof and wall panel assemblies from single source from single manufacturer.

2.2 SYSTEM DESCRIPTION

- A. Provide a complete, integrated set of mutually dependent components and assemblies that form a metal building system capable of withstanding structural and other loads, thermally induced movement, and exposure to weather without failure or infiltration of water into building interior.
- B. Primary-Frame Type:
 1. Rigid Clear Span: Solid-member, structural-framing system without interior columns.
- C. End-Wall Framing: Manufacturer's standard, for buildings not required to be expandable.
- D. Secondary-Frame Type: Manufacturer's standard purlins and joists and exterior-framed (bypass) girts.
- E. Eave Height: As indicated.
- F. Bay Spacing: As indicated.
- G. Roof Slope: As indicated.
- H. Roof System: Standing-seam, vertical-rib metal roof panels over open framing.
- I. Exterior Wall System: Metal wall panels with exposed fasteners over open framing.
- J. Exterior Soffit System: Metal soffit panels with concealed fasteners over open framing.

2.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design metal building system.
- B. Structural Performance: Metal building systems shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated according to procedures in MBMA's "Metal Building Systems Manual."
 1. Design Loads: As indicated on Drawings.
 2. Deflection and Drift Limits: No greater than the following:

- a. Purlins and Rafters: Vertical deflection of 1/180 of the span.
 - b. Girts: Horizontal deflection of 1/360 of the span where bracing masonry and 1/180 where no masonry exists.
 - c. Metal Roof Panels: Vertical deflection of 1/180 of the span.
 - d. Metal Wall and Soffit Panels: Horizontal deflection of 1/180 of the span.
 - e. Design secondary-framing system to accommodate deflection of primary framing and construction tolerances, and to maintain clearances at openings.
 - f. Lateral Drift: Maximum of 1/360 of the building height where supporting masonry and 1/180 where no masonry exists.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change: 120 deg F, ambient; 180 deg F material surfaces.
- D. Structural Performance for Metal Roof and Wall Panels: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 1592:
1. Wind Loads: As indicated on Drawings.
- E. Air Infiltration for Metal Roof Panels: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E 1680 at the following test-pressure difference:
1. Test-Pressure Difference: 6.24 lbf/sq. ft.
- F. Air Infiltration for Metal Wall Panels: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E 283 at the following test-pressure difference:
1. Test-Pressure Difference: 6.24 lbf/sq. ft.
- G. Water Penetration for Metal Roof Panels: No water penetration when tested according to ASTM E 1646 at the following test-pressure difference:
1. Test-Pressure Difference: 12 lbf/sq. ft.
- H. Water Penetration for Metal Wall Panels: No water penetration when tested according to ASTM E 331 at the following test-pressure difference:
1. Test-Pressure Difference: 12 lbf/sq. ft.
- I. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.
1. Uplift Rating: UL 90.
- J. Thermal Performance for Opaque Elements: Provide the following minimum R-values when tested according to ASTM C 1363 or ASTM C 518:
1. Roof: R-30, total.
 2. Walls: R-20, total.
- 2.4 STRUCTURAL-STEEL FRAMING
- A. Structural Steel: Comply with AISC 360, "Specification for Structural Steel Buildings."

- B. Bolted Connections: Comply with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
- C. Cold-Formed Steel: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" for design requirements and allowable stresses.
- D. Primary Framing: Manufacturer's standard primary-framing system, designed to withstand required loads and specified requirements. Primary framing includes transverse and lean-to frames; rafters, rake, and canopy beams; sidewall, intermediate, end-wall, and corner columns; and wind bracing.
 - 1. General: Provide frames with attachment plates, bearing plates, and splice members. Factory drill for field-bolted assembly. Provide frame span and spacing indicated.
 - 2. Rigid Modular Frames: I-shaped frame sections fabricated from shop-welded, built-up steel plates or structural-steel shapes.
 - 3. Frame Configuration: Single gable.
 - 4. Exterior Columns: Tapered.
 - 5. Rafters: Tapered.
- E. End-Wall Framing: Manufacturer's standard primary end-wall framing fabricated for field-bolted assembly to comply with the following.
 - 1. End-Wall and Corner Columns: I-shaped sections fabricated from structural-steel shapes; shop-welded, built-up steel plates; or C-shaped, cold-formed, structural-steel sheet.
- F. Secondary Framing: Manufacturer's standard secondary framing, including purlins, girts, eave struts, flange bracing, base members, gable angles, clips, headers, jambs, and other miscellaneous structural members. Unless otherwise indicated, fabricate framing from either cold-formed, structural-steel sheet or roll-formed, metallic-coated steel sheet, prepainted with coil coating, to comply with the following:
 - 1. Purlins: C- or Z-shaped sections; fabricated from built-up steel plates, steel sheet, or structural-steel shapes; minimum 2-1/2-inch- wide flanges.
 - a. Depth: 8 inch.
 - 2. Girts: C- or Z-shaped sections; fabricated from built-up steel plates, steel sheet, or structural-steel shapes. Form ends of Z-sections with stiffening lips angled 40 to 50 degrees from flange, with minimum 2-1/2-inch- wide flanges.
 - a. Depth: 8 inch.
 - 3. Eave Struts: Unequal-flange, C-shaped sections; fabricated from built-up steel plates, steel sheet, or structural-steel shapes; to provide adequate backup for metal panels.
 - 4. Flange Bracing: Minimum 2-by-2-by-1/8-inch structural-steel angles or 1-inch diameter, cold-formed structural tubing to stiffen primary-frame flanges.
 - 5. Sag Bracing: Minimum 1-by-1-by-1/8-inch structural-steel angles.
 - 6. Base or Sill Channels: Manufacturer's standard base channel, fabricated from zinc-coated (galvanized) steel sheet.
 - 7. Purlin and Girt Clips: Manufacturer's standard clips fabricated from steel sheet. Provide galvanized clips where clips are connected to galvanized framing members.
 - 8. Framing for Openings: Channel shapes; fabricated from cold-formed, structural-steel sheet or structural-steel shapes. Frame head and jamb of door openings and head, jamb, and sill of other openings.
 - 9. Miscellaneous Structural Members: Manufacturer's standard sections fabricated from cold-formed, structural-steel sheet; built-up steel plates; or zinc-coated (galvanized) steel sheet; designed to withstand required loads.
- G. Bracing: Rods, angles, or rigid portal frames as indicated.

1. Rods: ASTM A36/A36M; ASTM A572/A572M, Grade 50; or ASTM A529/A529M, Grade 50; minimum 1/2-inch- diameter steel; threaded full length or threaded a minimum of 6 inches at each end.
 2. Angles: Fabricated from structural-steel shapes to match primary framing, of size required to withstand design loads.
 3. Rigid Portal Frames: Fabricated from shop-welded, built-up steel plates or structural-steel shapes to match primary framing; of size required to withstand design loads.
- H. Anchor Rods: Headed anchor rods as indicated in Anchor Rod Plan for attachment of metal building to foundation.
- I. Materials:
1. W-Shapes: ASTM A992/A992M; ASTM A572/A572M, Grade 50 or 55; or ASTM A529/A529M, Grade 50 or 55
 2. Channels, Angles, M-Shapes, and S-Shapes: ASTM A36/A36M; ASTM A572/A572M, Grade 50 or 55; or ASTM A529/A529M, Grade 50 or 55.
 3. Plate and Bar: ASTM A36/A36M; ASTM A572/A572M, Grade 50 or 55; or ASTM A529/A529M, Grade 50 or 55.
 4. Steel Pipe: ASTM A53/A53M, Type E or S, Grade B.
 5. Cold-Formed Hollow Structural Sections: ASTM A500, Grade B or C, structural tubing.
 6. Structural-Steel Sheet: Hot-rolled, ASTM A1011/A1011M, Structural Steel (SS), Grades 30 through 55, or High-Strength Low-Alloy Steel (HSLAS) or High-Strength Low-Alloy Steel with Improved Formability (HSLAS-F), Grades 45 through 70; or cold-rolled, ASTM A1008/A1008M, Structural Steel (SS), Grades 25 through 80, or HSLAS, Grades 45 through 70.
 7. Metallic-Coated Steel Sheet: ASTM A653/A653M, SS, Grades 33 through 80, or HSLAS or HSLAS-F, Grades 50 through 80; with G60 coating designation; mill phosphatized.
 8. Metallic-Coated Steel Sheet Prepainted with Coil Coating: Steel sheet, metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A755/A755M.
 - a. Zinc-Coated (Galvanized) Steel Sheet: ASTM A653/A653M, SS, Grades 33 through 80, or HSLAS or HSLAS-F, Grades 50 through 80; with G90coating designation.
 - b. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A792/A792M, SS, Grade 50 or 80; with Class AZ50coating.
 9. Non-High-Strength Bolts, Nuts, and Washers: ASTM A307, Grade A, carbon-steel, hex-head bolts; ASTM A563 carbon-steel hex nuts; and ASTM F844 plain (flat) steel washers.
 - a. Finish: Plain, or either hot-dip zinc coating, ASTM F2329 Class C, or mechanically deposited zinc coating, ASTM B695 Class 50, where indicated.
 10. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.
 - a. Finish: Plain, or either hot-dip zinc coating, ASTM F2329 Class C, or mechanically deposited zinc coating, ASTM B695 Class 50, where indicated.
 11. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F3125/F3125M, Grade F1852, Type 1, heavy-hex head assemblies consisting of steel structural bolts with splined ends; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1 hardened carbon-steel washers.
 - a. Finish: Plain, or mechanically deposited zinc coating, ASTM B695 Class 50, where indicated.
 12. Unheaded Anchor Rods: ASTM F1554, Grade 36.

- a. Configuration: Straight.
 - b. Nuts: ASTM A563 heavy-hex carbon steel.
 - c. Plate Washers: ASTM A36/A36M carbon steel.
 - d. Washers: ASTM F436 hardened carbon steel.
 - e. Finish: Plain, or hot-dip galvanized, ASTM A 153, Class C where indicated.
13. Threaded Rods: ASTM A193/A193M.
- a. Nuts: ASTM A563 heavy-hex carbon steel.
 - b. Washers: ASTM F436 hardened carbon steel.
 - c. Finish: Plain, or either hot-dip zinc coating, ASTM F2329 Class C, or mechanically deposited zinc coating, ASTM B695 Class 50, where indicated.
- J. Finish: Factory primed. Apply specified primer immediately after cleaning and pretreating.
1. Clean and prepare in accordance with SSPC-SP2.
 2. Coat with manufacturer's standard primer. Apply primer to primary and secondary framing to a minimum dry film thickness of 1 mil.
 - a. Prime secondary framing formed from uncoated steel sheet to a minimum dry film thickness of 0.5 mil on each side.

2.5 METAL ROOF PANELS

- A. Standing-Seam, Vertical-Rib, Metal Roof Panels: Formed with vertical ribs at panel edges and striated pan between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels and engaging opposite edge of adjacent panels.
1. Metallic-Coated Steel Sheet: Facings of zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.
 - a. Nominal Thickness: 0.024 inch (24 gage).
 - b. Exterior Finish: Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 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: Regal Blue.
 2. Clips: One-piece fixed to accommodate thermal movement.
 3. Joint Type: Panels snapped together.
 4. Panel Coverage: 18 inches.
 5. Panel Height: 1-3/4 inches.
 6. Basis-of-Design: Medallion-Lok Snap Lock Panels as manufactured by McElroy Metal.

2.6 METAL WALL PANELS

- A. Exposed-Fastener, Tapered-Rib, Metal Wall Panels: Formed with raised, trapezoidal major ribs and intermediate stiffening ribs symmetrically spaced between major ribs; designed to be installed by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in side laps.
1. Metallic-Coated Steel Sheet: Facings of zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.
 - a. Nominal Thickness: 0.024 inch (24 gage).

- b. Exterior Finish: Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 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: Surrey Beige.
2. Panel Coverage: 36 inches.
3. Panel Surface: Shallow ribs.
4. Panel Thickness: 1-3/16 inches.
5. Basis-of-Design: Multi-Rib Panel as manufactured by McElroy Metal.

2.7 THERMAL INSULATION

- A. Unfaced Metal Building Insulation: ASTM C 665, Type I, glass fiber blanket insulation; 0.5 lb/cu ft density; with flame-spread index of 25 or less.
- B. Air and Vapor-Retarder Facing: Cross-woven, non-perforated, breathable polyolefin-coated fabric functioning as an air and water resistive barrier.
 1. Basis-of-Design: MaxTight as manufactured by Therm-All; www.therm-all.com.
 2. Air Permeance: Not greater than 0.02 perm when tested according to ASTM E 96/E 96M, Desiccant Method.
 3. Vapor Permeance:
 - a. 16 perms when tested according to ASTM E 96/E 96M, Desiccant Method.
 - b. 25 perms when tested according to ASTM E 96/E 96M, Water Method.
 4. UV Resistance: 6 months.
 5. Thickness: Nominal 0.018 inches per ASTM D 1777.
 6. Weight: 17.3 lb/1000 sf per ASTM D3776.
 7. Tensile Strength: 69/42 lb/in per ASTM D 882.
 8. Tearing Strength: 42/62 lb/in per ASTM D 4533.
- C. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.
- D. Vapor-Retarder Adhesive: Product recommended by vapor retarder manufacturer with demonstrated capability to bond facing material securely to substrates indicated.
- E. Retainer Strips: For securing insulation between supports, 0.025-inch nominal-thickness, formed, metallic-coated steel or PVC retainer strips colored to match insulation facing.

2.8 ACCESSORIES

- A. General: Provide accessories as standard with metal building system manufacturer and as specified. Fabricate and finish accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes. Comply with indicated profiles and with dimensional and structural requirements.
 1. Form exposed sheet metal accessories that are without excessive oil-canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
- B. Roof and Wall Panel Accessories: Provide components required for complete metal roof and wall panel assemblies including ridge closures, clips, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.

- C. Flashing and Trim: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.024-inch nominal uncoated steel thickness, prepainted with coil coating; finished to match adjacent metal panels.
1. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers.
 2. Opening Trim: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.024-inch (24 gage) nominal uncoated steel thickness, prepainted with coil coating. Trim head and jamb of door openings, and head, jamb, and sill of other openings.
- D. Gutters: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.024-inch (24 gage) nominal uncoated steel thickness, prepainted with coil coating; finished to match roof fascia and rake trim. Match profile of gable trim, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum 96-inch- long sections, sized according to SMACNA's "Architectural Sheet Metal Manual."
1. Gutter Supports: Fabricated from same material and finish as gutters.
 2. Strainers: Bronze, copper, or aluminum wire ball type at outlets.
- E. Downspouts: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.024-inch nominal uncoated steel thickness, prepainted with coil coating; finished to match metal wall panels. Fabricate in minimum 10-foot- long sections, complete with formed elbows and offsets.
1. Mounting Straps: Fabricated from same material and finish as gutters.
- F. Roof Curbs: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.048-inch nominal uncoated steel thickness prepainted with coil coating; finished to match metal roof panels; with welded top box and bottom skirt, and integral full-length cricket; capable of withstanding loads of size and height indicated.
1. Curb Subframing: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.060-inch (16 gage) nominal uncoated steel thickness, angle-, C-, or Z-shaped metallic-coated steel sheet.
 2. Insulation: 1-inch- thick, rigid type.
- G. Pipe Flashing: Premolded, EPDM pipe collar with flexible aluminum ring bonded to base.
- H. Materials:
1. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide fasteners with heads matching color of materials being fastened by means of plastic caps or factory-applied coating.
 - a. Fasteners for Metal Wall and Roof Panels: Self-drilling or self-tapping hex-head screws, stainless steel or zinc-plated carbon-steel, with EPDM sealing washer.
 - b. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws with hex washer head.
 - c. Blind Fasteners: High-strength aluminum or stainless-steel rivets.
 2. Corrosion-Resistant Coating: Cold-applied asphalt mastic, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.
 3. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107/C 1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.
 4. Metal Panel Sealants:

- a. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene-compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape of manufacturer's standard size.
- b. Joint Sealant: ASTM C 920; one part elastomeric polyurethane or polysulfide; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended by metal building system manufacturer.

2.9 FABRICATION

- A. General: Design components and field connections required for erection to permit easy assembly.
 1. Mark each piece and part of the assembly to correspond with previously prepared erection drawings, diagrams, and instruction manuals.
 2. Fabricate structural framing to produce clean, smooth cuts and bends. Punch holes of proper size, shape, and location. Members shall be free of cracks, tears, and ruptures.
- B. Tolerances: Comply with MBMA's "Metal Building Systems Manual" for fabrication and erection tolerances. In addition, comply with CMMA Specification No. 70 "Specifications for Electrical Overhead Traveling Cranes," and CMMA Specification No. 74 "Specification for Top Running and Under Running Single Girder Electric Overhead Traveling Cranes" for crane rail installation tolerances.
- C. Primary Framing: Shop fabricate framing components to indicated size and section, with baseplates, bearing plates, stiffeners, and other items required for erection welded into place. Cut, form, punch, drill, and weld framing for bolted field assembly.
 1. Make shop connections by welding or by using high-strength bolts.
 2. Join flanges to webs of built-up members by a continuous, submerged arc-welding process.
 3. Brace compression flange of primary framing with steel angles or cold-formed structural tubing between frame web and purlin web or girt web, so flange compressive strength is within allowable limits for any combination of loadings.
 4. Weld clips to frames for attaching secondary framing if applicable, or punch for bolts.
 5. Shop Priming: Prepare surfaces for shop priming according to SSPC-SP 2. Shop prime primary framing with specified primer after fabrication.
- D. Secondary Framing: Shop fabricate framing components to indicated size and section by roll forming or break forming, with baseplates, bearing plates, stiffeners, and other plates required for erection welded into place. Cut, form, punch, drill, and weld secondary framing for bolted field connections to primary framing.
 1. Make shop connections by welding or by using non-high-strength bolts.
 2. Shop Priming: Prepare uncoated surfaces for shop priming according to SSPC-SP 2. Shop prime uncoated secondary framing with specified primer after fabrication.
- E. Metal Panels: Fabricate and finish metal panels at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements. Comply with indicated profiles and with dimensional and structural requirements.
 1. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of metal panel.

2.10 SOURCE QUALITY CONTROL

- A. Special Inspection: Owner will engage a qualified special inspector to perform source quality control inspections and to submit reports.
 - 1. Accredited Manufacturers: Special inspections will not be required if fabrication is performed by an IAS AC472-accredited manufacturer approved by authorities having jurisdiction to perform such Work without special inspection.
 - a. After fabrication, submit copy of certificate of compliance to authorities having jurisdiction, certifying that Work was performed according to Contract requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with erector present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Before erection proceeds, survey elevations and locations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments to receive structural framing, with erector present, for compliance with requirements and metal building system manufacturer's tolerances.
- C. Proceed with erection only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition.
- B. Provide temporary shores, guys, braces, and other supports during erection to keep structural framing secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural framing, connections, and bracing are in place unless otherwise indicated.

3.3 ERECTION OF STRUCTURAL FRAMING

- A. Erect metal building system according to manufacturer's written instructions and drawings.
- B. Do not field cut, drill, or alter structural members without written approval from metal building system manufacturer's professional engineer.
- C. Set structural framing accurately in locations and to elevations indicated, according to AISC specifications referenced in this Section. Maintain structural stability of frame during erection.
- D. Base and Bearing 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. 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.

3. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
 - E. Align and adjust structural framing before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with framing. 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 will be completed and in service.
 - F. Primary Framing and End Walls: Erect framing level, plumb, rigid, secure, and true to line. Level baseplates to a true even plane with full bearing to supporting structures, set with double-nutted anchor bolts. Use grout to obtain uniform bearing and to maintain a level base-line elevation. Moist-cure grout for not less than seven days after placement.
 1. Make field connections using high-strength bolts installed according to RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt type and joint type specified.
 - a. Joint Type: Snug tightened or pretensioned as required by manufacturer.
 - G. Secondary Framing: Erect framing level, plumb, rigid, secure, and true to line. Field bolt secondary framing to clips attached to primary framing.
 1. Provide rake or gable purlins with tight-fitting closure channels and fasciae.
 2. Locate and space wall girts to suit openings such as doors and windows.
 3. Provide supplemental framing at entire perimeter of openings, including doors, windows, louvers, ventilators, and other penetrations of roof and walls.
 - H. Bracing: Install bracing in roof and sidewalls where indicated on erection drawings.
 1. Tighten rod and cable bracing to avoid sag.
 2. Locate interior end-bay bracing only where indicated.
 - I. Framing for Openings: Provide shapes of proper design and size to reinforce openings and to carry loads and vibrations imposed, including equipment furnished under mechanical and electrical work. Securely attach to structural framing.
 - J. Erection Tolerances: Maintain erection tolerances of structural framing within AISC 303.
- 3.4 METAL PANEL INSTALLATION, GENERAL
- A. Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
 - B. Examination: Examine primary and secondary framing to verify that structural-panel support members and anchorages have been installed within alignment tolerances required by manufacturer.
 1. Examine roughing-in for components and systems penetrating metal panels, to verify actual locations of penetrations relative to seams before metal panel installation.

- C. General: Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
 - 1. Field cut metal panels as required for doors, windows, and other openings. Cut openings as small as possible, neatly to size required, and without damage to adjacent metal panel finishes.
 - a. Field cutting of metal panels by torch is not permitted.
 - 2. Install metal panels perpendicular to structural supports unless otherwise indicated.
 - 3. Flash and seal metal panels with weather closures at perimeter of openings and similar elements. Fasten with self-tapping screws.
 - 4. Locate and space fastenings in uniform vertical and horizontal alignment.
 - 5. Lap metal flashing over metal panels to allow moisture to run over and off the material.
- D. Lap-Seam Metal Panels: Install screw fasteners using power tools with controlled torque adjusted to compress EPDM washers tightly without damage to washers, screw threads, or metal panels. Install screws in predrilled holes.
- E. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with corrosion-resistant coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by metal roof panel manufacturer.
- F. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of metal panel assemblies. Provide types of gaskets, fillers, and sealants indicated; or, if not indicated, provide types recommended by metal panel manufacturer.
 - 1. Seal metal panel end laps with double beads of tape or sealant the full width of panel. Seal side joints where recommended by metal panel manufacturer.
 - 2. Prepare joints and apply sealants to comply with requirements in Section 07 92 00 "Joint Sealants."

3.5 METAL ROOF PANEL INSTALLATION

- A. General: Provide metal roof panels of full length from eave to ridge unless otherwise indicated or restricted by shipping limitations.
 - 1. Install ridge caps as metal roof panel work proceeds.
 - 2. Flash and seal metal roof panels with weather closures at eaves and rakes. Fasten with self-tapping screws.
- B. Standing-Seam Metal Roof Panels: Fasten metal roof panels to supports with concealed clips at each standing-seam joint, at location and spacing and with fasteners recommended by manufacturer.
 - 1. Install clips to supports with self-drilling or self-tapping fasteners.
 - 2. Install pressure plates at locations indicated in manufacturer's written installation instructions.
 - 3. Snap Joint: Nest standing seams and fasten together by interlocking and completely engaging factory-applied sealant.
 - 4. Rigidly fasten eave end of metal roof panels and allow ridge end free movement for thermal expansion and contraction. Predrill panels for fasteners.
 - 5. Provide metal closures at peaks rake edges and each side of ridge caps.

- C. Metal Roof Panel Installation Tolerances: Shim and align metal roof panels within installed tolerance of 1/4 inch in 20 feet on slope and location lines and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.6 METAL WALL PANEL INSTALLATION

- A. General: Install metal wall panels in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to framing members, extending full height of building, unless otherwise indicated. Anchor metal wall panels and other components of the Work securely in place, with provisions for thermal and structural movement.
 1. Unless otherwise indicated, begin metal panel installation at corners with center of rib lined up with line of framing.
 2. Shim or otherwise plumb substrates receiving metal wall panels.
 3. When two rows of metal panels are required, lap panels 4 inches minimum.
 4. When building height requires two rows of metal panels at gable ends, align lap of gable panels over metal wall panels at eave height.
 5. Rigidly fasten base end of metal wall panels and allow eave end free movement for thermal expansion and contraction. Pre-drill panels.
 6. Flash and seal metal wall panels with weather closures at eaves and rakes, and at perimeter of all openings. Fasten with self-tapping screws.
 7. Install screw fasteners in pre-drilled holes.
 8. Install flashing and trim as metal wall panel work proceeds.
 9. Apply elastomeric sealant continuously between metal base channel (sill angle) and concrete, and elsewhere as indicated on Drawings; if not indicated, as necessary for waterproofing.
 10. Align bottom of metal wall panels and fasten with blind rivets, bolts, or self-drilling or self-tapping screws.
 11. Provide weatherproof escutcheons for pipe and conduit penetrating exterior walls.
- B. Installation Tolerances: Shim and align metal wall panels within installed tolerance of 1/4 inch in 20 feet, noncumulative; level, plumb, and on location lines; and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.7 THERMAL INSULATION INSTALLATION

- A. General: Install insulation concurrently with metal panel installation, in thickness indicated to cover entire surface, according to manufacturer's written instructions.
 1. Set air and vapor-retarder facing on interior side of insulation.
 2. Tape joints and ruptures in vapor retarder, and seal each continuous area of insulation to the surrounding construction to ensure airtight installation.
- B. Blanket Roof Insulation: Comply with the following installation method:
 1. Two-Layers-between-Purlin-with-Spacer-Block Installation: Extend insulation and vapor retarder between purlins. Carry vapor-retarder-facing tabs up and over purlin, overlapping adjoining facing of next insulation course and maintaining continuity of retarder. Install layer of filler insulation over first layer to fill space between purlins formed by thermal spacer blocks. Hold in place with bands and crossbands below insulation.
 - a. Thermal Spacer Blocks: Where metal roof panels attach directly to purlins, install thermal spacer blocks.
 2. Retainer Strips: Install retainer strips at each longitudinal insulation joint, straight and taut, nesting with secondary framing to hold insulation in place.

- C. Blanket Wall Insulation: Extend insulation and vapor retarder over and perpendicular to top flange of secondary framing. Hold in place by metal wall panels fastened to secondary framing.
 - 1. Retainer Strips: Install retainer strips at each longitudinal insulation joint, straight and taut, nesting with secondary framing to hold insulation in place.

3.8 ACCESSORY INSTALLATION

- A. General: 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 for complete metal wall and roof panel assemblies, including trim, copings, corners, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
 - 2. Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with corrosion-resistant coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by manufacturer.
- B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
 - 1. Install exposed flashing and trim that is without excessive oil-canning, 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 and weather-resistant performance.
 - 2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).
- C. Gutters: Join sections with riveted-and-soldered or lapped-and-sealed joints. Attach gutters to eave with gutter hangers spaced as required for gutter size, but not more than 36 inches o.c. using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.
- D. Downspouts: Join sections with 1-1/2-inch telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch away from walls; locate fasteners at top and bottom and at approximately 60 inches o.c. in between.
 - 1. Provide elbows at base of downspouts to direct water away from building.
 - 2. Tie downspouts to underground drainage system indicated.
- E. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to panel as recommended by manufacturer.

3.9 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform field quality control special inspections and to submit reports.
- B. Product will be considered defective if it does not pass tests and inspections.

- C. Prepare test and inspection reports.

3.10 CLEANING AND PROTECTION

- A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780/A 780M and manufacturer's written instructions.
- B. Touchup Painting: After erection, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted structural framing and accessories.
 - 1. Clean and prepare surfaces by SSPC-SP 2, "Hand Tool Cleaning," or by SSPC-SP 3, "Power Tool Cleaning."
 - 2. Apply a compatible primer of same type as shop primer used on adjacent surfaces.
- C. Metal Panels: Remove temporary protective coverings and strippable films, if any, as metal panels are installed. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.
 - 1. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

**SECTION 21 01 00 - FIRE PROTECTION OPERATING
AND MAINTENANCE MANUALS**

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Compilation product data and related information appropriate for Owner's operation and maintenance of products furnished under Contract. Prepare operating and maintenance data as specified.
- B. Instruct Owner's personnel in operation and maintenance of equipment and systems.
- C. Submit three copies of complete manual in final form.

1.2 SUBMITTALS

- A. Thirty (30) days after the Contractor has received the final scheduled identified submittals bearing the Architect / Engineer's stamp of acceptance (including resubmittals), submit for review one copy of the first draft of the Operating and Maintenance Manual. This copy shall contain as a minimum:
 - 1. Table of Contents for each element.
 - 2. Contractor information.
 - 3. All submittals, coordination drawings and product data, reviewed by the Architect / Engineer; bearing the Architect / Engineer's stamp of acceptance. (When submittals are returned from Engineer "Correct as Noted", corrected inserts shall be included.)
 - 4. All parts and maintenance manuals for items of equipment.
 - 5. Warranties (without starting dates)
 - 6. Certifications that have been completed. Submit forms and outlines of certifications that have not been completed.
 - 7. Operating and maintenance procedures.
 - 8. Form of Owner's Training Program Syllabus (including times and dates).
 - 9. Control operations/equipment wiring diagrams.
 - 10. Other required operating and maintenance information that are complete.
- B. Copy will be returned to the Contractor within 15 days with comments for corrections.
- C. Submit completed manuals in final electronic form to the Architect / Engineer one day after substantial completion, and prior to Owner's instructions. Include all specified data, test and balance reports, drawings, dated warranties, certificates, reports, along with other materials and information.
- D. The Architect / Engineer will review the manuals for completeness within fifteen (15) days.
- E. The Contractor shall be notified of any missing or omitted materials. The Manuals shall be reworked by the Contractor, as required, in the office of the Architect / Engineer. The manuals will not be retransmitted.
- F. Completed electronic manuals will be delivered to the Owner.

PART 2 - PRODUCTS

2.1 BINDERS

- A. Commercial quality black three-ring binders with clear overlay plastic covers.
- B. Minimum ring size: 1".
Maximum ring size: 3".
- C. When multiple binders are used, correlate the data into related groupings.
- D. Label contents on spine and face of binder with full size insert. Label under plastic cover.

PART 3 - EXECUTION

3.1 OPERATION AND MAINTENANCE MANUAL

- A. Form for 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 flyleaf 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 21.

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

SECTION 21 05 00 - FIRE PROTECTION GENERAL PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Except as modified in this Section, General Conditions and Supplementary Conditions, applicable provisions of the General Requirements, and other provisions and requirements of the contract documents apply to work of Division 21 Fire Sprinkler Systems.
- B. Applicable provisions of this section apply to all sections of Division 22, Plumbing.

1.2 CODE REQUIREMENTS AND FEES

- A. Perform work in accordance with applicable statutes, ordinances, codes and regulations of governmental authorities having jurisdiction.
- B. Plumbing work shall comply with applicable inspection services:
 - 1. Underwriters Laboratories
 - 2. National Fire Protection Association
 - 3. State Health Department
 - 4. Local Municipal Building Inspection Department
 - 5. Texas Department of Licensing & Regulations (TDLR)
 - 6. Texas Accessibility Standards (TAS Based on ADA)
- C. Resolve any code violations discovered in contract documents with the Engineer prior to award of the contract. After Contract award, any correction or additions necessary for compliance with applicable codes shall be made at no additional cost to the Owner.
- D. This Contractor shall be responsible for being aware of and complying with asbestos NESHAP regulations, as well as all other applicable codes, laws and regulations.
- E. Obtain all permits required.

1.3 CONTRACTOR'S QUALIFICATIONS

- A. 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 has served their Owners satisfactorily for not less than 3 years

1.4 REFERENCE SPECIFICATIONS AND STANDARDS

- A. Materials which are specified by reference to Federal Specifications; ASTM, ASME, ANSI, or AWWA Specifications; Federal Standards; or other standard specifications must comply with latest editions, revisions, amendments or supplements in effect on date bids are received. Requirements in reference specifications and standards are minimum for all equipment, material, and work. In instances where specified capacities, size, or other features of equipment, devices, or materials exceed these minimums, meet specified capacities.

1.5 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.

1.6 PROJECT RECORD DOCUMENTS

- A. Maintain at the job site a separate set of white prints (blue line or black line) of the contract drawings for the sole purpose of recording the "as-built" changes and diagrams of those portions of work in which actual construction is at variance with the contract drawings. Mark the drawings with a colored pencil. Prepare, as the work progresses and upon completion of work, reproducible drawings clearly indicating locations of various lines, valves, ductwork, traps, equipment, and other pertinent items, as installed. Include flow-line elevation of sewer lines. Record existing and new underground and under slab piping with dimensioned locations and elevations of such piping.
- B. At the conclusion of project, obtain without cost to the Owner, erasable mylars of the original drawings and transfer as-built changes to these. Prior to transmittal of corrected drawings, obtain 3 sets of blue-line prints of each drawing, regardless of whether corrections were necessary and include in the transmittal (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 (reproducible Dayrex mylar film positives) and AutoCad 2012 / Revit CAD files on disk (CD Rom).
- C. 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 RECORD DRAWINGS.
 - 4. Clearly indicate: DOCUMENT PRODUCED BY
 - 5. Indicate all changes to construction during construction. Indicate actual routing of all piping, etc. that were deviated from construction drawings.
 - 6. Correct schedules to reflect (actual) equipment furnished and manufacturer.
 - 7. 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.
 - 8. Location and size of all ductwork and mechanical piping above ceiling including exact location of isolation of domestic and plumbing valves.
 - 9. Exact location of all electrical equipment in and outside of the building.
 - 10. Fire Protection System documents revised to indicate exact location of all sprinkler heads and zone valves.
 - 11. Exact location of all roof mounted equipment, wall, roof and floor penetrations.
 - 12. Cloud all changes.

1.7 SPACE REQUIREMENTS

- A. Consider space limitations imposed by contiguous work in selection and location of equipment and material. Do not provide equipment or material that is not suitable in this respect.

1.8 RELATION WITH OTHER TRADES

- A. Carefully study all matters and conditions concerning the project. Submit notification of conflict in ample time to prevent unwarranted changes in any work. Review other Divisions of these specifications to determine their requirements.
- B. Because of the complicated relationship of this work to the total project, conscientiously

study the relation and cooperate as necessary to accomplish the full intent of the documents.

- C. Provide sleeves and inserts in forms as required for the work. Stub up and protect open ends of pipe before any concrete is placed. Furnish sizes of required equipment pads. Furnish and locate bolts and fittings required to be cast in them.
- D. Locate and size openings required for installation of work specified in this Division in sufficient time to prevent delay in the work.
- E. Refer to other Divisions of the specifications for the scope of required connections to equipment furnished under that Division. Determine from the Contractor for the various trades, the Owner, and by direction from the Architect/Engineer, the exact location of all items.

1.9 CONCEALED AND EXPOSED WORK

- A. When the word "concealed" is used in connection with insulating, painting, piping, ducts and the like, the work is understood to mean hidden from sight as in chases, furred spaces or above ceilings. "Exposed" is understood to mean open to view.

1.10 GUARANTEE

- A. Guarantee work for 1 year from the date of substantial completion of the project. During that period make good any faults or imperfections that may arise due to defects or omissions in material, equipment or workmanship. At the Owner's option, replacement of failed parts or equipment shall be provided.

1.11 MATERIAL AND EQUIPMENT

- A. Furnish new and unused materials and equipment meeting the requirements of the paragraph specifying acceptable manufacturers. Where two or more units of the same type or class of equipment are required, provide units of a single manufacturer.

1.12 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 building structure by equipment, piping, ducts or other parts of work, rectify such conditions at no additional cost. If the item of equipment is judged to produce objectionable noise or vibration, demonstrate at no additional cost that equipment performs within designated limits on a vibration chart.

1.13 ACCEPTABLE MANUFACTURERS

- A. Manufacturers names and catalog number specified under sections of Division 21 are used to establish standards of design, performance, quality and serviceability and not to limit competition. Equipment of similar design, equal to that specified, manufactured by a named manufacturer will be acceptable on approval. A request for prior approval of equipment not listed must be submitted ten (10) days before bid due date. Submit complete design and performance data to the Engineer.

1.14 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 operation throughout the range of operation. Tests shall be made in the presence of the

Architect/Engineer. Make adjustments as required to ensure proper functioning of all systems. Special tests on individual systems are specified under individual sections. Submit 3 copies of all certifications and test reports adequately in advance of completion of the work to allow for remedial action as required to correct deficiencies discovered in equipment and systems.

1.15 WARRANTIES

- A. Submit 3 copies of all warranties and guarantees for systems, equipment, devices and materials. These shall be included in the Operating and Maintenance Manuals.

1.16 BUILDING CONSTRUCTION

- A. It shall be the responsibility of each sub-contractor to consult the Architectural and Engineering drawings, details, and specifications and thoroughly familiarize himself with the project and all job related requirements. Each sub-contractor shall cooperate with the General Contractor to verify that all piping and other items are placed in the walls, furred spaces, chases, etc., so there will be no delays in the job.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1 OPENINGS

- A. Framed, cast or masonry openings for ductwork, equipment or piping are specified under other divisions. Drawings and layout work for exact size and location of all openings are included under this division.

3.2 HOUSEKEEPING PADS

- A. Provide equipment housekeeping pads under all floor mounted and ground mounted plumbing equipment, and as shown on the drawings.
- B. Concrete work as specified in Division 3.
- C. Concrete pads:
 - 1. 4" high, rounded edges, minimum 2500 psi unless otherwise indicated on the drawings
 - 2. Chamfer strips at edges and corner of forms.
 - 3. Smooth steel trowel finish.
 - 4. Doweled to existing slab
- D. Install concrete curbs around multiple pipe penetrations.

3.3 VANDAL RESISTANT DEVICES

- A. Provide a handle for each loose keyed operated valve and hose bibb on the project.
- B. Where vandal resistant screws or bolts are employed on the project, deliver to the Owner 2 suitable tools for use with each type of fastener used.
- C. Proof of delivery of these items to the Owner shall be included in the Operating and Maintenance Manuals.

3.4 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 plumbing 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 plumbing systems and with the project.
- B. Time to be allocated for instructions.
 - 1. Minimum of 4 hours dedicated instructor time.
 - 2. 2 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 Operating and Maintenance Manual.

3.5 EQUIPMENT IDENTIFICATION

- A. Provide a laminated engraved plastic nameplate on each piece of equipment and starter.
 - 1. Designation approved by Architect/Engineer.
 - 2. Equipment includes, but is not limited to, water heaters, pumps, boilers and utility controllers.
 - 3. Submit schedule of equipment to be included and designations.
- B. Provide nameplates with 1/2" high letters and fastened with epoxy or screws.

3.6 OBSTRUCTIONS

- A. The drawings indicate certain information pertaining to surface and subsurface obstructions which has been taken from available drawings. Such information is not guaranteed, however, as to accuracy of location or complete information.
 - 1. Before any cutting or trenching operations are begun, verify with Owner's representative, utility companies, municipalities, and other interested parties that all available information has been provided.
 - 2. Should obstruction be encountered, whether shown or not, alter routing of new work, reroute existing lines, remove obstruction where permitted, or otherwise perform whatever work is necessary to satisfy the purpose of the new work and leave existing services and structures in a satisfactory and serviceable condition.
- B. Assume total responsibility for and repair any damage to existing utilities or construction, whether or not such existing facilities are shown.

3.7 PROTECTION

- A. Protect work, equipment, fixtures, and materials. At work completion, work must be clean and in original manufacturer's condition.

END OF SECTION

SECTION 21 05 10 - FIRE PROTECTION CONTRACT QUALITY CONTROL

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Contract quality control including workmanship, manufacturer's instructions and demonstrations.

1.2 QUALITY CONTROL PROGRAM

- A. Maintain quality control over supervision, subcontractors, suppliers, manufacturers, products, services, site conditions and workmanship to produce work in accordance with contract documents.

1.3 WORKMANSHIP

- A. Comply with industry standards except when more restrictive tolerances or specified requirements indicate more rigid standards or more precise workmanship.
- B. Perform work by persons qualified to produce workmanship of specified quality.
- C. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, and racking. Under no conditions shall material or equipment be suspended from structural bridging.
- D. Provide finishes to match approved samples. All exposed finishes shall be approved by the Architect. Submit color samples as required.

1.4 MANUFACTURER'S INSTRUCTIONS

- A. Comply with instructions in full detail, including each step in sequence.
- B. Should instruction conflict with Contract Documents, request clarification from Architect / Engineer before proceeding.

1.5 MANUFACTURER'S CERTIFICATES

- A. When required in individual Specification Sections, submit manufacturer's certificate in duplicate, certifying that products meet or exceed specified requirements.

1.6 MANUFACTURER'S FIELD SERVICES

- A. When required in individual Specification Sections, manufacturer shall provide qualified personnel to observe:
 - 1. Field conditions.
 - 2. Condition of installation.
 - 3. Quality of workmanship.
 - 4. Start-up of equipment.
 - 5. Testing, adjusting, and balancing of equipment.
- B. Representative shall make written report of observations and recommendations to Architect / Engineer.

PART 2 - PRODUCTS

2.1 REFERENCE APPLICABLE SPECIFICATION SECTIONS.

PART 3 - EXECUTION

3.1 PROTECTION OF EQUIPMENT

- A. 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 a like kind at no additional cost to the Owner.
- B. Adequately protect equipment from damage after delivery to the project. Cover with heavy tarpaulins, drop cloths or other protective coverings as required to protect from plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion.

END OF SECTION

**SECTION 21 05 12 - FIRE PROTECTION SHOP DRAWINGS, COORDINATION
DRAWINGS & PRODUCT DATA**

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Prepare submittals as required by Division 1.
- B. The term submittal, as used herein, refers to all:
 - 1. Shop Drawings
 - 2. Coordination Drawings
 - 3. Product data
- C. Submittals shall be prepared and produced for:
 - 1. Distribution as specified
 - 2. Inclusion in the Operating and Maintenance Manual, as specified, in the related section

1.2 SHOP DRAWINGS

- A. Present drawings in a clear and thorough manner. Identify details by reference to sheet and detail, schedule, or room numbers shown on Contract Drawings.
- B. Show all dimensions of each item of equipment on a single composite Shop Drawing. Do not submit a series of drawings of components.
- C. Identify field dimensions; show relationship to adjacent features, critical features, work, or products.
- D. Submit shop drawings in plan, elevation and sections, showing equipment in mechanical equipment areas.

1.3 COORDINATION DRAWINGS

- A. Present in a clear and thorough manner. Title each drawing with project name. Identify each element of drawings by reference to sheet number and detail, or room number of contract documents. Minimum drawing scale: $\frac{1}{4}'' = 1'-0''$.
- B. Prepare coordination drawings to coordinate installations for efficient use of available space, for proper sequence of installation, and to resolve conflicts. Coordinate with work specified in other sections and other divisions of the specifications.
- C. For each mechanical room and for each outside equipment pad where equipment is located, submit plan and elevation drawings. Show:
 - 1. Actual mechanical equipment and components to be furnished
 - 2. Service clearance
 - 3. Relationship to other equipment and components
 - 4. Roof drains and leader piping
 - 5. Fire protection piping and equipment
- D. Identify field dimensions. Show relation to adjacent or critical features of work or products.
- E. Related requirements:

1. Ductwork shop drawings
 2. Coordination drawing specified in Division 26
- F. Submit shop drawings in plan, elevation and sections, showing equipment in mechanical equipment areas.
- G. Gas piping sketch indicating proposed location of piping prior to proceeding with the installation.

1.4 PRODUCT DATA AND INSTALLATION INSTRUCTION

- A. Submit only pages which are pertinent to the project. All options which are indicated on the product data shall become part of the contract and shall be required whether specified are not.
- B. Mark each copy of standard printed data to identify pertinent products, referenced to specification section and article number.
- C. Show reference standards, performance characteristics and capacities; wiring and piping diagrams and controls; component parts; finishes; dimensions and required clearances.
- D. Modify manufacturer's standard schematic drawings and diagrams to supplement standard information and to provide information specifically applicable to the work. Delete information not applicable.
- E. Mark up a copy of the specifications for the product. Indicate in the margin of each paragraph the following: "Comply, "Do Not Comply", or "Not Applicable". Explain all "Do Not Comply" statements.
- F. Provide a separate transmittal for each submittal item. Transmittals shall indicate product by specification section name and number. Separate all submittals into appropriate specification section number. Do not combine specification sections.

1.5 MANUFACTURERS INSTRUCTIONS

- A. Submit Manufacturer's instructions for storage, preparation, assembly, installation, start-up, adjusting, calibrating, balancing and finishing.

1.6 CONTRACTOR RESPONSIBILITIES

- A. Review submittals prior to transmittal.
- B. Determine and verify:
1. Field measurements
 2. Field construction criteria
 3. Manufacturer's catalog numbers
 4. Conformance with requirements of Contract Documents
- C. Coordinate submittals with requirements of the work and of the Contract Documents.
- D. Notify the Architect / Engineer in writing at time of submission of any deviations in the submittals from requirements of the Contract Documents.
- E. Do not fabricate products, or begin work for which submittals are specified, until such submittals have been produced and bear contractor's stamp. Do not fabricate products or

begin work scheduled to have submittals reviewed until return of reviewed submittals with Architect / Engineer's acceptance.

- F. Contractor's responsibility for errors and omissions in submittals is not relieved whether Architect / Engineer reviews submittals or not.
- G. Contractor's responsibility for deviations in submittals from requirements of Contract Documents is not relieved whether Architect / Engineer reviews submittals or not, unless Architect / Engineer gives written acceptance of the specific deviations on reviewed documents.
- H. Submittals shall show sufficient data to indicate complete compliance with Contract Documents:
 - 1. Proper sizes and capacities
 - 2. That the item will fit in the available space in a manner that will allow proper service
 - 3. Construction methods, materials and finishes
- I. Schedule submissions at least 15 days before date reviewed submittals will be needed.

1.7 SUBMISSION REQUIREMENTS

- A. Make submittals promptly in accordance with approved schedule, and in such sequence as to cause no delay in the Project or in the work of any other Contractor.
- B. Number of submittals required:
 - 1. Shop Drawings and Coordination Drawings: Submit one reproducible transparency and three opaque reproductions.
 - 2. Product Data: Submit the number of copies which the contractor requires, plus those which will be retained by the Architect / Engineer.
- C. Accompany submittals with transmittal letter, in duplicate, containing:
 - 1. Date
 - 2. Project title and number
 - 3. Contractor's name and address
 - 4. The number of each Shop Drawing, Project Datum and Sample submitted
 - 5. Other pertinent data
- D. Submittals shall include:
 - 1. The date of submission
 - 2. The project title and number
 - 3. Contract Identification
 - 4. The names of:
 - a. Contractor
 - b. Subcontractor
 - c. Supplier
 - d. Manufacturer
 - 5. Identification of the product
 - 6. Field dimensions, clearly identified as such
 - 7. Relation to adjacent or critical features of the work or materials
 - 8. Applicable standards, such as ASTM or federal specifications numbers
 - 9. Identification of deviations from contract documents
 - 10. Suitable blank space for General Contractor and Architect / Engineer stamps
 - 11. Contractor's signed and dated Stamp of Approval

- E. Coordinate submittals into logical groupings to facilitate interrelation of the several items:
 - 1. Finishes which involve Architect / Engineer selection of colors, textures or patterns
 - 2. Associated items which require correlation for efficient function or for installation

1.8 SUBMITTAL SPECIFICATION INFORMATION

- A. Every submittal document shall bear the following information as used in the project manual:
 - 1. The related specification section number
 - 2. The exact specification section title
- B. Submittals delivered to the Architect / Engineer without the specified information will not be processed. The Contractor shall bear the risk of all delays, as if no submittal had been delivered.

1.9 RESUBMISSION REQUIREMENTS

- A. Make re-submittals under procedures specified for initial submittals.
 - 1. Indicate that the document or sample is a re-submittal
 - 2. Identify changes made since previous submittals
- B. Indicate any changes which have been made, other than those requested by the Architect / Engineer.

1.10 CONTRACTOR'S STAMP OF APPROVAL

- A. Contractor shall stamp and sign each document certifying to the review of products, field measurements and field construction criteria, and coordination of the information within the submittal with requirements of the work and of Contract Documents.
- B. Contractor's stamp of approval on any submittal shall constitute a representation to Owner and Architect / Engineer that Contractor has either determined and verified all quantities, dimensions, field construction criteria, materials, catalog numbers, and similar data or assumes full responsibility for doing so, and that Contractor has reviewed or coordinated each submittal with the requirements of the work and the Contract Documents.
- C. Do not deliver any submittals to the Architect / Engineer that do not bear the Contractor's stamp of approval and signature.
- D. Submittals delivered to the Architect / Engineer without Contractor's stamp of approval and signature will not be processed. The Contractor shall bear the risk of all delays, as if no submittal had been delivered.

1.11 ARCHITECT / ENGINEER REVIEW OF IDENTIFIED SUBMITTALS

- A. The Architect / Engineer will:
 - 1. Review identified submittals with reasonable promptness and in accordance with schedule
 - 2. Affix stamp and initials or signature, and indicate requirements for re-submittal or approval of submittal
 - 3. Return submittals to Contractor for distribution or for resubmission

- B. Review and approval of submittals will not extend to design data reflected in submittals which is peculiarly within the special expertise of the Contractor or any party dealing directly with the Contractor.
- C. Architect / Engineer's review and approval is only for conformance with the design concept of the project and for compliance with the information given in the contract.
 - 1. The review shall not extend to means, methods, sequences, techniques or procedures of construction or to safety precautions or programs incident thereto.
 - 2. The review shall not extend to review of quantities, dimensions, weights or gauges, fabrication processes or coordination with the work of other trades.
- D. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.

1.12 SUBSTITUTIONS

- A. Do not make requests for substitution employing the procedures of this Section.
- B. The procedure for making a formal request for substitution is specified in Div. 1.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION

**SECTION 21 05 13 - ELECTRICAL PROVISIONS OF
FIRE PROTECTION WORK**

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Electrical provisions to be provided as fire protection work are indicated in other Division 21 sections, on drawings, and as specified.
- B. Types of work, normally recognized as electrical but provided as fire protection, specified or partially specified in this Section, include but are not necessarily limited to the following:
 - 1. Motors for fire protection equipment.
 - 2. Starters for motors of fire protection equipment, but only where specifically indicated to be furnished integrally with equipment.
 - 3. Wiring from motors to disconnect switches or junction boxes for motors of fire protection equipment, but only where specifically indicated to be furnished integrally with equipment.
 - 4. Wiring of field-mounted float control switches, flow control switches, and similar fire protection-electrical devices provided for fire protection systems, to equipment control panels.
 - 5. Pipe heat tracing.
- C. Refer to Division 21 sections for specific individual fire protection equipment electrical requirements.
- F. Refer to Division 26 sections for motor starters and controls not furnished integrally with fire protection equipment.
- G. Refer to Division 26 sections for junction boxes and disconnect switches required for motors and other electrical units of fire protection equipment.

1.2 RELATED WORK

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Specification Sections, apply to work of this Section.

1.3 QUALITY ASSURANCE

- A. Wherever possible, match elements of electrical provisions of fire protection work with similar elements of electrical work specified in Division 26 sections for electrical work not otherwise specified.
- B. For electrical equipment and products, comply with applicable NEMA standards, and refer to NEMA standards for definitions of terminology. Comply with National Electrical Code (NFPA 70) for workmanship and installation requirements.

1.4 SUBMITTALS

- A. Include in listing of motors, voltage, notation of whether motor starter is furnished or installed integrally with motor or equipment containing motors.

PART 2 - PRODUCTS

2.1 MOTORS

- A. Provide motors for fire protection equipment manufactured by one of the following:
1. Baldor Electric Company.
 2. Century Electric Div., Inc.
 3. General Electric Co.
 4. Louis Allis Div.; Litton Industrial Products, Inc.
 5. Lincoln Electric
 6. Marathon Electric Mfg. Corp.
 7. Reliance Electric Co.
 8. Westinghouse Electric Corp.
- B. Motor Characteristics. Except where more stringent requirements are indicated, and except where required items of fire protection equipment cannot be obtained with fully complying motors, comply with the following requirements for motors of fire protection work:
- C. Temperature Rating. Rated for 40°C environment with maximum 50°C temperature rise for continuous duty at full load (Class A Insulation).
- D. Provide each motor capable of making starts as frequently as indicated by automatic control system, and not less than 5 starts per hour for manually controlled motors.
- E. Phases and Current Characteristics. Provide squirrel-cage induction polyphase motors for 3/4hp and larger, and provide capacitor-start single-phase motors for 1/2hp and smaller, except 1/6hp and smaller may, at equipment manufacturer's option, be split-phase type. Coordinate current characteristics with power specified in Division 26 sections, and with individual equipment requirements specified in other Division 21 requirements. For 2-speed motors provide 2 separate windings on polyphase motors. Do not purchase motors until power characteristics available at locations of motors have been confirmed, and until rotation directions have been confirmed.
- F. Service Factor. 1.15 for polyphase motors and 1.35 for single-phase motors.
- G. Motor Construction. Provide general purpose, continuous duty motors, Design "B" except "C" where required for high starting torque.
1. Frames. NEMA #56.
 2. Bearings are to be ball or roller bearings with inner and outer shaft seals, regreasable except permanently sealed where motor is inaccessible for regular maintenance. Where belt drives and other drives produce lateral or axial thrust in motor, provide bearings designed to resist thrust loading. Refer to individual section of Division 21 for fractional-hp light-duty motors where sleeve-type bearings are permitted.
 3. Except as indicated, provide open drip-proof motors for indoor use where satisfactorily housed or remotely located during operation, and provide guarded drip-proof motors where exposed to contact by employees or building occupants. Provide weather-protected Type I for outdoor use, Type II where not housed. Refer to individual sections of Division 21 for other enclosure requirements.
 4. Provide built-in thermal overload protection and, where indicated, provide internal sensing device suitable for signaling and stopping motor at starter.
 5. Noise Rating: Provide "Quiet" rating on motors.
- H. All motors shall be premium efficiency.

2.2 EQUIPMENT FABRICATION

- A. Fabricate fire protection equipment for secure mounting of motors and other electrical items included in work. Provide either permanent alignment of motors with equipment, or adjustable mountings as applicable for belt drives, gear drives, special couplings and similar indirect coupling of equipment. Provide safe, secure, durable, and removable guards for motor drives. Arrange for lubrication and similar running-maintenance without removal of guards.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install motors on motor mounting systems in accordance with motor manufacturer's instructions, anchored to resist torque, drive thrusts, and other external forces inherent in fire protection work. Secure sheaves and other drive units to motor shafts with keys and Allen set screws on flat surface of shaft. Unless otherwise indicated, set motor shafts parallel with machine shafts.
- B. Verify voltage with Electrical Plans.

END OF SECTION

**SECTION 21 05 14 - FIRE PROTECTION ALTERATIONS
PROJECT PROCEDURES**

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Inspect and service existing equipment and materials that are to remain or to be reused.
- B. Disposal of equipment, materials, or housekeeping pads to be abandoned. Prior to disposal, the Contractor shall verify with the Owner what is to be salvaged by the Owner and what is to become the property of the Contractor.
- C. Handling of equipment and materials to be removed.

1.2 QUALITY ASSURANCE

- A. Coordination with the Owner prior to the disconnection or shutdown of existing equipment, or to the modification of existing operational systems.

1.3 CONTRACT DRAWINGS

- A. There is the possibility that existing conditions and devices are affected by the work indicated on the drawings and called for in the specifications (project manual) that do not appear on the drawings. It is the Contractor's responsibility to visit the site and determine all of the existing conditions and to consider these existing conditions when making and presenting a proposal, to have a complete proposal.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Material used to upgrade and repair existing equipment shall conform to that specified.
- B. Material used to upgrade and repair existing equipment shall not void existing warranties or listings of the equipment to be upgraded or repaired.
- C. Material used to upgrade and repair existing equipment shall be new and shall be of the same manufacturer of the existing equipment, shall be acquired through the existing original equipment manufacturer's approved distribution channels, shall have manufacturer's warranties for the new material being used, and shall be listed for the use intended.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Existing materials and equipment indicated on the drawings or in the specifications to be reused shall be inspected for damaged or missing parts. Contractor shall notify the Architect/Engineer, in writing, accordingly.
- B. If using materials specified or shown on the drawing voids or diminishes the warranty or operation of remaining equipment or systems, the Contractor shall notify the Architect/Engineer, in writing.

- C. Verify field measurements, above and underground piping connections and flows.
- D. Demolition Drawings are based on casual field observation, and when available, existing record documents. Report discrepancies to Architect before disturbing existing installation, and immediately after such discrepancies are discovered.
- E. Field verify existing conditions and actual utility uses prior to final connections. Existing drawings may not have been available for all required information.

3.2 APPLICATION

- A. Existing materials and equipment indicated on the drawings or in the specifications to be reused shall be cleaned and reconditioned, including cleaning of piping systems prior to installation and reuse, or abandon.
- B. Material and equipment removed that is not to be salvaged for Owner's use or for reuse on the project shall become the property of the Contractor and be removed from the site.
- C. Material or equipment salvaged for Owner's use shall be carefully handled and stored where directed by the Owner or the Architect / Engineer. Relocate material and / or equipment as directed by Owner.
- D. Materials and equipment not indicated to be removed or abandoned shall be reconnected to the new system.
- E. Materials, equipment and housekeeping pads not to be reused or reconnected shall be removed for Owner's review and salvaged by Contractor.
- F. Prior to start of construction, Contractor shall walk areas to be renovated with Owner to identify and document items to be salvaged for Owner's use.
- G. Clean and repair existing materials and equipment that remain or are to be reused.
- H. Contractor shall utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

3.3 SEQUENCE AND SCHEDULE

- A. Coordinate utility service outages with Utility Company, Architect and Owner.
- B. Provide additional or temporary valves, piping and connections to maintain existing systems in service during construction.
- C. Existing Fire Protection Service: Refer to drawings for work in remodeled areas. Where facilities in these areas are to remain in service, any related work to keep the facilities in operation is specified in this Division. Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Obtain permission from Owner at least 48 hours before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area. Maintain acceptable temperature and humidity control within existing building during renovation activities.
- D. Remove and replace existing fire protection systems and appurtenances as occasioned by new or remodeled construction. Re-establish service that may be interrupted by remodeled construction.

- E. Refer to other drawings series for work in remodeled areas. Where facilities in these areas are required to remain in service, any related work required to keep these facilities in operation is specified in this Division.
- F. Remove and replace existing piping coincident with the construction.

3.4 DEMOLITION AND EXTENSION OF EXISTING FIRE PROTECTION WORK

- A. The Contractor shall modify, remove, and/or 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 the property of the Owner, and shall be delivered to such destination as directed by the Owner's representative unless they are not wanted, then it will be the responsibility of this Contractor to remove such items and properly dispose of them. Materials and/or items scheduled for relocation and which are damaged during dismantling or reassembly operations shall be repaired and restored to good operative condition. The Contractor may, at his discretion, and upon approval of the Owner's representative substitute new materials and/or items of like design and quality in lieu of materials and/or items to be relocated.
- B. All items 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 relocations and to restore them 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.
- C. When items scheduled for relocation and/or reuse are found to be in damaged condition before work has been started on dismantling, the Contractor shall call the attention of the Owner's representative to such items and receive further instructions before removal. Items damaged in repositioning operations are the contractor's responsibility and shall be repaired or replaced by the contractor as approved by the owner's representative, at no additional cost to the Owner.
- D. Fire protection piping and appurtenances to be removed, salvaged, or relocated shall be removed to points indicated on the drawings, specified, or acceptable to the Owner's representative. Piping 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 disconnected in a safe manner acceptable to the Construction Inspector. All disconnections or connections into the existing facilities shall be done in such a manner as to result in minimum interruption of services to adjacent occupied areas. Services to existing areas or facilities that must remain in operation during the construction period shall not be interrupted without prior specific approval of the Owner's representative hereinbefore specified.
- E. Repair adjacent construction and finishes damaged during demolition and extension work.
- F. Maintain access to mechanical installations that remain active. Modify installation or provide access panel as appropriate.
- G. Extend existing installations using materials and methods compatible with existing fire protection installation, or as specified.
- H. Existing fire protection piping and devices found to need additional hangers installed

should be added at no additional cost to the Owner.

3.5 PROTECTION OF THE WORK

- A. Provide adequate temporary support and auxiliary structure as necessary to ensure structural value or integrity of affected portion of work.
- B. Provide devices and methods to protect other portions of work from damage.
- C. Execute fitting and adjustment of products to provide a finished installation to comply with specified products, functions, tolerances and finishes.

3.6 IDENTIFICATION OF EQUIPMENT IN RENOVATED AREAS

- A. Identification of Equipment: Provide new identification of all existing equipment to be reused and located within the renovated areas. Do not include the description "existing". Provide new nameplates for all existing equipment in renovated areas as specified in Section 21 05 00 Fire Protection General Provisions.

END OF SECTION

SECTION 21 10 00 - FIRE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Design coordination of sprinkler work with the installations of other trades as shown on their drawings; all mechanical, electrical, plumbing and sprinkler work must fit the space requirements. The sprinkler work shall comply with other Sections of this specification; and fit the structure finishes. The Sprinkler Contractor will comply with all the codes and underwriter authorities, and the requirements for the installation of inside and outside piping; including sprinkler heads, valves, tamper switches, flow switches, hangers and supports, sleeves, fire department connections, inspector test connections, main drain and accessories, signs and any other component parts reasonably incidental to providing a complete protection system. Provide 100 percent coverage for the entire building.
- B. A wet system shall be installed in heated areas and dry pipe systems in areas subject to freezing. When heated areas are not available and dry pipe system not used, provide heat tracing and / or insulation installed per NFPA and per local Fire Marshall Requirements, or as indicated on drawings.
- C. Furnish all articles of a completed sprinkler system including all materials, labor, tools, equipment, transportation services and supervision fees.
- D. The plans provide a riser assembly location at water entry into building for flow switch locations, valve locations (with tamper switches), fire department test assemblies and fire department Siamese connections. These are a guide for subsequent preparation of the Contractor's detailed installation drawings of the complete fire protection sprinkler system which shall be submitted to the Architect / Engineer for review. Submit only drawings and calculations bearing the approval of the authority having jurisdiction.
- E. Do not exceed 52,000 square feet of building for each individual sprinkler system.
- F. Install fire protective system identification signs in accordance with NFPA-13, NFPA-14, and NFPA-20
- G. It shall be the fire protection installer's responsibility, prior to bid, to verify pressure at the project site by performing a flow test. Determine if the available static pressure, residual pressure and flow rate will adequately provide the fire extinguishing system with the necessary operating requirements or if a fire pump, storage tank and necessary appurtenances are required. Notify Architect and Engineer if low water flow / pressure condition exist and inform them of all options prior to proceeding.
- H. The installation of the entire Sprinkler Systems shall comply with all rules and regulations of the National Board of Fire Underwriters, the Local Building Code, Local Fire Marshall, and Requirements of NFPA Pamphlet 13, and other local authorities exercising jurisdiction.
- I. Study the general, structural, electrical and mechanical drawings and specifications, in order to become familiar with the building and details as they apply to the work of this Section. Cooperate with all Trades so that there will be no conflict of space. Plumbing flow lines, large ductwork HVAC piping and electrical service feeders shall take precedence over Fire Protection work, except where it is absolutely necessary to maintain coverage protection.

- J. Provide a water curtain sprinkler system along glazing to create a 1-hour rating, as outlined in NFPA 13. Refer to Architecture plans for locations. Water demand for water curtain shall be added to the ceiling sprinkler water demand at the point of connection, per NFPA 13. Sprinkler heads shall be spaced at 6'-0" o.c., minimum 6 inches and maximum 12 inches from glazing.

1.2 BASIS OF DESIGN

- A. National Fire Protection Association (NFPA), latest edition of NFPA 13, Standard for the Installation of Sprinkler Systems.
- B. Vertical zone valves installed in horizontal position are not acceptable. All zone valves are to be located at water entry into building and mounted in the vertical riser.

1.3 QUALITY ASSURANCE

- A. Sprinkler equipment and installation to be in accordance with recommendations of and approved by local, state and federal fire authorities.
- B. Equipment and installation to meet requirements of NFPA No. 13, 14, 20, 24, 25, 70 and 72.
- C. Use materials and equipment that are new and of unused, approved by NFPA and as listed in the UL list of "Inspected Fire Protection Equipment and Materials."

1.4 SHOP DRAWINGS

- A. Make complete shop drawings and working drawings of equipment furnished, including detailed drawings of piping and sprinkler head locations. Drawings shall show construction details and dimensions of each piece of equipment and work to be installed. The location of all heads shall be as approved. Where additional heads are required to meet NFPA 13, provide at no additional cost.
- B. Before the shop drawings are submitted to Architect / Engineer, submit drawings to the jurisdictions for approval. All approvals shall be noted on the drawings or by letter from the departments.
- C. The Architect's approval of shop drawings shall not relieve the responsibility of correctly figured dimensions or any errors that may be contained in these drawings. The omission of any material shown on the contract drawings, or specified from the shop drawings, even though approved, shall not relieve the responsibility to furnish and erect them.
- D. The drawings show the location of the water entry into building. Install all zone valves at this location. Prepare the sprinkler drawings under the work of this Section.
- E. Submit samples of all sprinkler types for approval.
- F. Provide flow rates for sprinkler system and for Inspector's Sprinkler Test Drains.

1.5 ACCEPTABLE MANUFACTURERS

- A. Tyco Fire Products
 - 1. Anvil
 - 2. Gem
 - 3. Central

- B. Automatic Sprinkler Company of America
- C. Potter Roemer, Inc.
- D. The Reliable Automatic Sprinkler Company
- E. Viking Corporation
- F. Victaulic Company of America
- G. Grinnell

PART 2 - PRODUCTS

2.1 PIPING AND FITTINGS

- A. Above Slab Inside Building
 - 1. Pipe 2" and Smaller: Schedule 40, black steel pipe conforming to ASTM A 795 or ASTM A135 joined with threaded fittings.
 - 2. Pipe 2-1/2" and larger, provide ASTM A795 or ASTM A135 UL and FM listed.
 - a. Schedule. 40, black steel pipe joined with rolled grooved fittings.
- B. Underground within five feet of building. Provide IBR pipe, in building riser, NFPA 24, UL/FM approved. Provide concrete thrust blocks at changes in direction, according to the pipe manufacturer's recommendations.
- C. All piping shall be black carbon steel, except in dry systems where pipe shall be galvanized per ASTM A53.
- D. Fittings used to join pipe shall be listed fabricated fittings or manufactured in accordance to the material and dimension standards listed in table 6.4.1 NFPA 13 and 2.2.1 NFPA 14.
- E. Sprinkler branch tap connections, tees, cross outlet with female threaded or grooved that requires hole drilling of main pipe is not acceptable and will not be allowed.

2.2 SPRINKLER HEAD

- A. All sprinklers shall comply with the latest requirements of NFPA 13 with respect to orifice size.
- B. All heads shall be UL listed and FM approved, and comply with the latest requirements of NFPA 13 with respect to orifice size unless otherwise noted. Sprinkler heads with "O" ring design shall not be acceptable.
- C. Exposed areas:
 - 1. Standard upright type with brass finish and escutcheon. Provide temperature rating per NFPA 13 and UL/FM approvals.
 - 2. Tyco Model B, FRB, or approved equal
- D. Sidewall applications:
 - 1. Horizontal sidewall type with brass finishes and chrome escutcheon.
 - 2. Unfinished areas and recessed with chrome plated escutcheon. Provide temperature rating per NFPA 13 and UL/FM approvals.

3. Tyco Model B, FRB, or approved equal.
- E. Suspended ceilings:
1. Adjustable drop down deflector type concealed heads with manufacturer painted white cover plate with glass bulb fusible link. Provide temperature rating per NFPA 13 and UL/FM approvals.
 2. Color of plate, selected by Architect
 3. Tyco Series RFII; Series ELOC, or approved equal.
- F. Dry sprinklers heads at freezers and coolers
1. Tyco Model DS-1, DS-2, or approved equal.
- G. Sprinklers subject to mechanical injury shall be protected with fusible solder type sprinklers and heavy duty mechanically fastened guards. Provide Sprinkguard "Threadguard" two-piece system threads into fire line fitting; secured with two 5/16 inch bolts and Nylock nuts. Bulb type sprinklers will not be acceptable for these locations.
1. Storage rooms with exposed structure.
 2. Gymnasiums.
 3. Mechanical and Electrical rooms.
 4. Below exposed stairs.
 5. Exposed structure areas.
- H. In Elevator Machine Rooms, ensure shunt trip is incorporated into the fire alarm system as per current code requirements.
1. Acceptable Manufacturers
 - a. Reliable
 - b. Grinnell
 - c. Viking
- I. Systems serving walk-in freezers shall utilize Tyco Model DS-1 or DS-C dry pendent sprinklers. A Model DSB-1 dry sprinkler boot shall be utilized in conjunction with the dry sprinkler to eliminate the requirement for insulation and to stop potential air interchange. Length of dry pendent shall be determined by manufacturer's recommendation with respect to freezer ambient temperatures expected.
- J. In Kiln Rooms, Review and coordinate exact Kiln to be provided and location of Kiln. Provide sprinkler head with higher temperature requirements. Coordinate exact temperature requirement with Fire Marshal and Kiln manufacturer.
1. Acceptable Manufacturers:
 - a. Tyco
 - b. Reliable
 - c. Grinnell
 - d. Viking

2.3 INSPECTOR'S TEST CONNECTION

- A. Provide inspector's test connection as required by NFPA 13.
1. Ductile iron module housing with combination sight glass, orifice and bonnet assembly
 2. UL listed
 3. Victaulic No. 718
 4. Tyco or approved equal

- B. Do not terminate drain valves and test drains onto sidewalks. Pipe to designated floor sink in mechanical room or route sprinkler test drain piping to specific locations as noted on Plumbing Drawings.
- C. Provide flow rates for each Inspector's Test Drain.

2.4 TAMPER SWITCH / SUPERVISORY SWITCH

- A. Tamper switch on each valve
 1. Controlling or shutting off sprinkler system or any portion thereof.
 2. Tamper switch with either one single pole, double throw switch or two single pole, double throw switches as required.
 3. Switch shall be compatible with installed valve for standard mounting.
 4. Potter-Roemer Fig. 6220, 6221, 6222, 6223 or approved equal.

2.5 FLOW SWITCH

- A. Vane type flow switch.
 1. Self-contained pneumatic, adjustable retard.
 2. Two, single pole, double throw switches.
 3. Red enamel tamper proof switch housing with flow paddle.
 4. Potter Roemer Model No. 6200, or approved equal.

2.6 FLOORS AND CEILING PLATES

- A. 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.

2.7 DOMESTIC MANUFACTURE

- A. All piping material, pipe and pipe fittings shall be manufactured in the United States of America.

2.9 GASKETS

- A. Use 1/16-inch thick preformed synthetic rubber bonded.

2.10 COUPLINGS

- A. Use listed rolled grooved mechanical couplings to engage and lock grooved or shouldered pipe ends and to allow for some angular deflection, contraction and expansion. Coupling consists of ductile iron housing, c-shaped composition sealing gasket and steel bolts. Gasket Material for dry pipe systems shall be silicone and listed for dry pipe service.

2.11 VALVES

- A. Use valves suitable for 175 psig WOG.
- B. Valves to be UL listed and FM approved.
- C. Valve Connections:
 1. Provide valves suitable to connect adjoining piping as specified for pipe joints. Use full line size valves unless noted otherwise.

2. Screwed ends for pipe sizes 2 inches and smaller.
 3. Flanged ends for pipe sizes 2-1/2 inches and larger.
 4. Solder or screw to solder adapters for copper tubing.
 5. Use grooved body valves with mechanical grooved jointed piping.
- D. Gate Valves:
1. Up to 2 inches, bronze, outside screw and yoke, rising stem, solid wedge, screwed ends, manufactured by: Mueller, or approved equal.
 2. Over 2 inches, iron body, bronze trim, outside screw and yoke, rising stem, solid wedge, flanged ends; manufactured by Mueller, or approved equal by Nibco, Grinnell, Stockham and Victaulic.
- E. Check Valves:
1. Up to 2 inch, bronze, regrind bronze swing disk, solder or screwed ends; 200 WOG, manufactured by Mueller, or approved equal.
 2. Over 2 inch, iron body bronze trim, swing disk, regrind – renew bronze disk and seat, flanged ends; 200 WOG, manufactured by Mueller, or approved equal by Nibco, Grinnell, Stockham and Victaulic.
- F. Butterfly Valve: Lug body style, bubble-tight shutoff, cast iron body, ASTM B 148 bronze disk, with integral tamper switch, manufactured by Anvil Model No. 8000 FP, or approved equal.
- G. Freestanding Indicating Post: Install adjustable indicating post and valve outside building where shown on Civil drawings, consisting of UL/FM, non-rising stem gate valve and indicating post. Gate valve shall be iron body, non-rising stem, bronze mounted. Indicator flange, 175-psi non-shock rating, flanged end. Indicator shall be UL/FM approved cast iron body, Plexiglas window and 18-inch adjustment span with handle and tamper switch wired to main fire alarm control panel, manufactured by Mueller, Valve No. A-2052, Indicating Post No. A20800, or approved equal.
- H. Wall post-adjustable indicating valve: Outside building at water entry location into building, consisting of UL/FM, non-rising stem gate valve and indicator. Gate valve shall be iron body, non-rising stem, bronze mounted. Indicator flange, 175-psi non-shock rating, flanged end. Indicator shall be UL/FM approved cast iron body, Plexiglas window and 18-inch adjustment span with handle, manufactured by Mueller, Valve No. A-2052, Indicating Post No. A20800, or approved equal.
- 2.12 ELECTRIC ALARM BELL
- A. 10-inch round red enamel steel bell with electrically operated vibrating outdoor alarm bell, UL listed, red enamel steel, manufactured by Simplex, or approved equal.
- 2.13 GAUGES
- A. Gauges shall be bourdon tube type with minimum 4-1/2 inch dial and die cast aluminum case with screwed ring and black enamel finish. The movement shall be all stainless steel with Grade A phosphor bronze bourdon tube, brazed at socket and tip. The accuracy of the gauge shall be within one-half of one percent of the scale range. The pointer shall be the micrometer adjustment type recalibrated from the front. Pressure and compound gauges shall have suitable scale ranges and graduations. Suitable for temperatures up to 120 degrees F.
- B. Gauges shall have ¼ inch connections and be mounted with combination stop / snubber needle valve with suitable pressure rating. Scale ranges: 0-200 psi.

- C. Gauge range shall be such that system normal operating pressure falls with 25 percent and 75 percent of the full-scale range.
- D. Pressure scale graduations shall read in psig. Figure intervals shall be in – 20 psig increments, with minor divisions in 2 psig increments.
- E. The accuracy of the gauge shall be at least 0.5 percent of the scale range. Gauge shall be made in accordance with ASME B40.1 accuracy grade 2A.
- F. Manufactured by:
 - 1. Trerice Model No. 4500 Series
 - 2. Ashcroft
 - 3. Marsh
 - 4. Weksler

2.14 SPARE SPRINKLER HEAD BOX

- A. Provide baked enamel steel box to store 36 sprinkler heads (Minimum of 3 of each type used) for emergency replacement. Provide sprinkler wrench.

2.15 ALARM CHECK VALVE

- A. Provide UL listed check valve.
 - 1. Variable for City Supplied systems pressure trim set.
 - 2. Constant for Fire Pump Systems pressure trim set.
 - 3. Tyco AV-1 or approved equal by Reliable, Grinnell and Viking.

PART 3 - EXECUTION

3.1 DESIGN

- A. Design, spacing of sprinkler heads and selection sizes shall conform to the requirements of NFPA 13 for the indicated occupancy.
- B. Uniform discharge density design shall be based on hydraulic calculations using the method outlined in NFPA 13. Density of discharge from sprinkler heads shall conform to NFPA 13.
- C. Friction losses in pipe will be based on a value of “C” = 120 in the Hazen and Williams formula.
- D. Design and install the system so that no part will interfere with doors, windows, heating, mechanical, lighting or electrical equipment. Do not locate sprinkler heads closer than 3 feet to lighting fixtures or other obstructions.

3.2 LOCATION

- A. Heads shown, if indicated on reflected ceiling plans, are an integral part of the ceiling design. Where heads are not shown or indicated, locate them in the exact center of acoustical ceiling tile unless noted otherwise. In rooms with monolithic plaster or gypsum drywall ceilings, locate the sprinkler heads symmetrically arranged with respect to both axes of the room. Locate sprinkler heads in relation to specialty ceiling elements such as slats, ribs, panels, grids, etc., if not shown on the drawings. Generally, locate heads in the exact center of, or spaced between, such elements. Center heads in corridors.

- B. Locate heads as may be required for coordinated ceiling pattern, even through number of heads exceed minimum code requirements.
- C. Sprinkler heads located in utility or mechanical rooms, penthouses, service corridors, or other such spaces not subject to public view need not be centered in ceiling patterns and may use a straight drop from branch line.
- D. Install a water curtain sprinkler system along glazing to create a 1-hour rating, as outlined in NFPA 13. Refer to plans for locations. Water demand for water curtain shall be added to the ceiling sprinkler water demand at the point of connection, per NFPA 13. Sprinkler heads shall be spaced at 6'-0" on center, minimum 6 inches and maximum 12 inches from glazing.
- E. Where glazing shall be installed in 2-hour fire rated assemblies, the Tyco Window sprinkler shall be utilized as outlined in the ICC Legacy report equivalency requirements. Any glazing requiring fire exposure protection shall also utilize the Tyco window sprinklers.

3.3 PREPARATION

- A. Ream pipes and tubes, clean off scale, rust, oxide and dirt, inside and outside, before assembly. Remove welding slag or other foreign material from piping.
- B. Pipe beveled each end, per approved procedures.
- C. Hammer clean and flush out piping after welding to remove scale, welding slag and other debris.

3.4 CONNECTION

- A. Make screwed joints with square, clean full cut standard taper pipe threads. Ream after cutting and threading. Red lead and linseed oil or other approved non-toxic joint compound applied to male threads only.
- B. Nipples: Shoulder type; extra heavy where less than 1-1/2 inch is unthreaded.
- C. Clamp cast iron water pipe at fittings with 3/4 inch rods and properly anchor and support.
- D. Use grooved mechanical couplings and mechanical fasteners only in accessible locations.

3.5 COORDINATION

- A. Coordinate the installation schedule for this work with the construction schedule for the Work to ensure orderly progress with minimum delay.
- B. Coordinate interface of fire sprinkler system with the work of other trades to ensure proper and adequate provision for the installation and connection of this system.
- C. Coordinate location and quantity of Siamese connections required for fire department connection with Architect and local fire officials.

3.6 SURFACE CONDITIONS

- A. Before starting each stage of the fire sprinkler systems installation, inspect the installed work of other trades and determine that work is complete enough to allow installation to begin. Ensure that work of other trades has been installed in a manner to permit work of this Section in accordance with approved design.

3.7 INSTALLATION

- A. Run piping concealed above furred ceilings and in joists to minimize obstructions. Expose only heads.
- B. Protect sprinkler heads against mechanical injury with heavy duty bolt-on guards.
- C. Locate system drains and inspector's test connections to drain to floor drain inside mechanical rooms or other readily accessible areas not requiring access through ceiling. Coordinate sprinkler system drain flow rates with plumbing system drainage capacities.
 - 01. Sprinkler Contractor shall note that all sprinkler test drains, in all locations, shall be routed back to the nearest mechanical room and terminated within a floor sink or trench. All valve locations and pipe routing shall be in an accessible location. By no means shall it be acceptable for the termination to occur in other locations unless specifically noted on the MEP plans. Do not terminate drains and test drains onto sidewalks.
- D. Where low points or drains occur above ceilings or in otherwise finished spaces, furnish drain valve with brass cap and chain.
- E. Locate outside alarms on wall of building and coordinate with Architect.
- F. Fire pump and all accessories shall be tested in accordance with NFPA 20 and the local Fire Marshall and/or all other authorities having jurisdiction.
- G. Provide on interior wall near sprinkler valve, cabinet containing extra sprinkler heads of each type and wrench suitable for each head type.
- H. Provide a minimum 18-inch radius swing joint for each drop to sprinkler heads located in ceilings. **NO FLEXIBLE SPRINKLER HEAD CONNECTORS ALLOWED.**
- I. Install pipe markers to identify fire protection.
- J. Provide shield or deflector for sprinklers or equipment where electrical switchgear, switchboards and motor control centers are in sprinkler protected spaces.
- K. Install fire 2-1/2 inch department valve, maximum 5 feet above floor, complying with NFPA 14.
- L. During construction, make one standpipe outlet available on each floor without delay, for fire department use.
- M. Provide 3-way standpipe outlets above roof.
- N. Provide pressure gauges at the top of each standpipe as detailed on the drawings.
- O. Provide drain for each standpipe.
- P. Install valves with stems upright or horizontal, not inverted.

- Q. Sprinkler heads shall be installed above and below ductwork over 48 inches wide, in exposed areas, per NFPA 13.
- R. Install the complete fire sprinkler system in accordance with the approved shop drawings.
- S. Perform piping installation in accordance with the provisions of the specifications, including furnishing of required sleeves for fire sprinkler system pipes passing through rated walls, floors, and other parts of the building. Provide scheduled 40 galvanized pipe sleeve for concrete or CMU penetrations. Furnish size required for fireproofing and or insulation. Furnish and install split wall plates and chrome plated escutcheons for exposed fire sprinkler system pipes. Where pipes pass through concrete floors, furnish and install wrought iron or steel pipe sleeves made flush with the ceiling below and extending 2" above the finished floor.
- T. Do not cut or make holes in any part of the building except where shown on the approved shop drawings.
- U. Furnish and install, next to the sprinkler riser main, a print sheet protected by glass or a transparent plastic cover, giving brief instructions regarding control, emergency procedure, and other data required by NFPA #13. For hydraulically designed sprinkler systems, a placard is to be permanently attached to the riser indicating the location, and the basis of design (discharge density and system demand).
- V. Do not install exposed piping below structure in public area.
- W. Provide heat tracing and insulation on wet piping systems exposed to freezing when not installed in a heated space or installed by other acceptable methods of maintaining the piping from freezing. Installation of heat tracing and insulation shall be in accordance with the latest edition of NFPA 13 and the local code authorities. Coordinate electrical requirements with Division 26.
- X. Do not intrude onto or overlap into sidewalk areas with (FDC) Fire Department Connection.

3.8 SECURING AND SUPPORTING

- A. Support piping to maintain line and grade, with provision for expansion and contraction. Use approved hangers per NFPA 13 connected to structural members of the building. Do not support piping from other piping or structural joist bridging. Note that saddle clamps are not allowed and not approved for supporting piping.
- B. Provide supports both sides of elbows for pipe 6" and larger.
- C. Support vertical risers with steel strap pipe clamps of approved design and size, supported at each floor. Support piping assemblies in chases so they are rigid and self-supported before the chase is closed.
- D. Support spacing: As recommended by the project structural engineer and support manufacturer, but not more than listed below. Not to exceed spacing requirements of smallest pipe.

| Pipe Size | Steel Max. Support Spacing, Feet | Minimum Rod Diameter, Inches |
|-----------------|----------------------------------|------------------------------|
| 1" & smaller | 6 | 3/8 |
| 1-1/4" & 1-1/2" | 8 | 3/8 |

| | | |
|--------------|----|-----|
| 2" | 10 | 3/8 |
| 3" | 10 | 1/2 |
| 4" & 5" | 10 | 5/8 |
| 6" and above | 10 | 3/4 |

3.9 PIPE SUPPORTS

- A. Provide sprinkler piping supports per NFPA 13.

3.10 PIPE SLEEVES

- A. Sleeves through masonry and concrete construction:
 - 1. Fabricate sleeves of Schedule 40 galvanized steel pipe.
 - 2. Size sleeve large enough to allow for movement due to expansion and to provide continuous insulation.
- B. Sleeves through gypsum wall construction.
 - 1. Fabricate sleeves of 16 gauge galvanized sheet metal.
- C. Sleeves through elevated slab construction.
 - 1. Fabricate sleeves of Schedule 40 galvanized steel pipe with welded center flange in floor.
- D. Extend each sleeve through the floor or wall. Cut the sleeve flush with each wall surface. Sleeves through floors shall extend 2" above floor lines for waterproofing purposes. Slab on grade floors shall not be sleeved except where penetrating waterproofing membrane or insect control is required.
- E. Caulk sleeves water and airtight. Seal annular space between pipes and sleeves with mastic compound to make the space water and air tight.
- F. For sleeves below grades in outside walls, provide Thunderline Link-Seal or Advance Product and System Interlynx, with 316 stainless steel nuts and bolts, with cast iron pressure plate.
- G. Provide chrome plated escutcheon plates on pipes passing through walls, floors or ceilings exposed to view. At exterior walls, stainless steel sheet metal is to be used.
- H. For sleeves through fire and smoke rated walls, seal with a UL through-penetration firestop, rated to maintain the integrity of the time rated construction. Install in accordance with the manufacturer's installation instructions. Comply with UL and NFPA standards for the installation of firestops. Refer to Architectural drawings for all fire and smoke rated partitions, walls, floors, etc.

3.11 CLEANING OF PIPING SYSTEMS

- A. 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.

3.12 FLUSHING AND TESTING

- A. Testing and flushing of installation of sprinkler system shall be in accordance with NFPA 13, and NFPA 25.

- B. Flush sprinkler piping in accordance with NFPA 13. Additionally, flush all alarm valves, and all main piping up to valve.
- C. In addition to NFPA 13 required tests, provide flow switch test and tamper switch test for each device, and verify alarm valve operation.
- D. All tests shall be witnessed by Architect / Engineer. Contractor shall notify Architect / Engineer 7 working days in advance.

3.13 EXCAVATING, TRENCHING, AND BACKFILLING

- A. Perform excavation, trenching, and backfilling for this portion of the work in accordance with the specifications.

3.14 PIPE MARKERS

- A. Identify interior main piping and exposed in mechanical room piping with Opti-Code Brady Pressure Sensitive Adhesive Pipe Markers, consisting of pipe marker and direction of flow arrow tape. Clean pipe prior to installation. Background colors of markers, arrows and tape for each type of system shall be the same. Meet ANSI/OSHA standards and clearly identify each system. Provide minimum 2-1/4-inch letters through 4-inch pipe and 4-inch letters for 5-inch pipe and larger.
- B. Install identification in the following locations:
 - 1. Both sides of penetrations through walls, floors and ceilings.
 - 2. Close to valves or flanges.
 - 3. Intervals on straight pipe runs not to exceed 50 feet
 - 4. Apply marker where view is obstructed.
- C. Pipe markers shall meet or exceed the specifications of the ASME A13.1 "Scheme for Identification of Piping Systems".

3.15 TESTING AND ACCEPTANCE

- A. Prior to connecting to the overhead sprinkler piping, flush the underground main. Secure required approvals of the flushing operations.
- B. Upon completion of the fire sprinkler system installation, test and retest the complete installation and make corrections as necessary to obtain acceptance by the Fire Marshall and/or any other authority having jurisdiction. Furnish test equipment and personnel required.

3.16 TRAINING

- A. At a time mutually agreed upon, provide 4 hours of instruction to the Owner's designated personnel on the operation and maintenance of the automatic sprinkler system and associated equipment. Owner's Operation and Maintenance Manual prepared for this project shall be used during the instruction.

END OF SECTION

**SECTION 22 01 00 –
PLUMBING OPERATING AND MAINTENANCE MANUALS**

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Compilation product data and related information appropriate for Owner's operation and maintenance of products furnished under Contract. Prepare operating and maintenance data as specified.
- B. Instruct Owner's personnel in operation and maintenance of equipment and systems.
- C. Submit three copies of complete manual in final form.

1.2 SUBMITTALS

- A. Thirty (30) days after the Contractor has received the final scheduled identified submittals bearing the Architect/Engineer's stamp of acceptance (including resubmittals), submit for review one copy of the first draft of the Operating and Maintenance Manual. This copy shall contain as a minimum:
 - 1. Table of Contents for each element.
 - 2. Contractor information.
 - 3. All submittals, coordination drawings and product data, reviewed by the Architect/Engineer; bearing the Architect/Engineer's stamp of acceptance. (When submittals are returned from Engineer "Correct as Noted", corrected inserts shall be included.)
 - 4. All parts and maintenance manuals for items of equipment.
 - 5. Warranties (without starting dates)
 - 6. Certifications that have been completed. Submit forms and outlines of certifications that have not been completed.
 - 7. Operating and maintenance procedures.
 - 8. Form of Owner's Training Program Syllabus (including times and dates).
 - 9. Control operations/equipment wiring diagrams.
 - 10. Other required operating and maintenance information that are complete.
- B. Copy will be returned to the Contractor within 15 days with comments for corrections.
- C. Submit completed manuals in final electronic form to the Architect/Engineer one day after substantial completion, and prior to Owner's instructions. Include all specified data, test and balance reports, drawings, dated warranties, certificates, reports, along with other materials and information.
- D. The Architect/Engineer will review the manuals for completeness within fifteen (15) days.
- E. The Contractor shall be notified of any missing or omitted materials. The Manuals shall be reworked by the Contractor, as required, in the office of the Architect / Engineer. The manuals will not be retransmitted.
- F. Completed electronic manuals will be delivered to the Owner.

PART 2 - PRODUCTS

2.1 BINDERS

- A. Commercial quality black three-ring binders with clear overlay plastic covers.
- B. Minimum ring size: 1".
Maximum ring size: 3".
- C. When multiple binders are used, correlate the data into related groupings.
- D. Label contents on spine and face of binder with full size insert. Label under plastic cover.

PART 3 - EXECUTION

3.1 OPERATION AND MAINTENANCE MANUAL

- A. Form for 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 flyleaf 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 22.
 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.
10. Provide gas piping pressure test reports.

END OF SECTION

SECTION 22 05 00 - PLUMBING GENERAL PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Except as modified in this Section, General Conditions, Supplementary Conditions, applicable provisions of the General Requirements, and other provisions and requirements of the contract documents apply to work of Division 22 Plumbing.
- B. Applicable provisions of this section apply to all sections of Division 22, Plumbing.

1.2 CODE REQUIREMENTS AND FEES

- A. Perform work in accordance with applicable statutes, ordinances, codes and regulations of governmental authorities having jurisdiction.
- B. Plumbing work shall comply with applicable inspection services:
 - 1. Underwriters Laboratories
 - 2. National Fire Protection Association
 - 3. State Health Department
 - 4. Local Municipal Building Inspection Department
 - 5. Texas Department of Licensing & Regulations (TDLR)
 - 6. Texas Accessibility Standards (TAS Based on ADA)
- C. Resolve any code violations discovered in contract documents with the Engineer prior to award of the contract. After Contract award, any correction or additions necessary for compliance with applicable codes shall be made at no additional cost to the Owner.
- D. This Contractor shall be responsible for being aware of and complying with asbestos NESHAP regulations, as well as all other applicable codes, laws and regulations.
- E. Obtain all permits required.

1.3 CONTRACTOR'S QUALIFICATIONS

- A. 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 has served their Owners satisfactorily for not less than 3 years

1.4 REFERENCE SPECIFICATIONS AND STANDARDS

- A. Materials which are specified by reference to Federal Specifications; ASTM, ASME, ANSI, or AWWA Specifications; Federal Standards; or other standard specifications must comply with latest editions, revisions, amendments or supplements in effect on date bids are received. Requirements in reference specifications and standards are minimum for all equipment, material, and work. In instances where specified capacities, size, or other features of equipment, devices, or materials exceed these minimums, meet specified capacities.

1.5 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.

1.6 PROJECT RECORD DOCUMENTS

- A. Maintain at the job site a separate set of white prints (blue line or black line) of the contract drawings for the sole purpose of recording the "as-built" changes and diagrams of those portions of work in which actual construction is at variance with the contract drawings. Mark the drawings with a colored pencil. Prepare, as the work progresses and upon completion of work, reproducible drawings clearly indicating locations of various lines, valves, ductwork, traps, equipment, and other pertinent items, as installed. Include flow-line elevation of sewer lines. Record existing and new underground and under slab piping with dimensioned locations and elevations of such piping.
- B. At the conclusion of project, obtain without cost to the Owner, erasable mylars of the original drawings and transfer as-built changes to these. Prior to transmittal of corrected drawings, obtain 3 sets of blue-line prints of each drawing, regardless of whether corrections were necessary and include in the transmittal (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 (reproducible Dayrex mylar film positives) and AutoCad 2012 / Revit CAD files on disk (CD Rom).
- C. 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 RECORD 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 elevation.
 - 7. Indicate exact location of all underground plumbing piping and elevation.
 - 8. Indicate exact location of all underground electrical raceways and elevations.
 - 9. Correct schedules 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 plumbing 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.

1.7 SPACE REQUIREMENTS

- A. Consider space limitations imposed by contiguous work in selection and location of equipment and material. Do not provide equipment or material that is not suitable in this respect.

1.8 RELATION WITH OTHER TRADES

- A. Carefully study all matters and conditions concerning the project. Submit notification of conflict in ample time to prevent unwarranted changes in any work. Review other Divisions of these specifications to determine their requirements.
- B. Because of the complicated relationship of this work to the total project, conscientiously

study the relation and cooperate as necessary to accomplish the full intent of the documents.

- C. Provide sleeves and inserts in forms as required for the work. Stub up and protect open ends of pipe before any concrete is placed. Furnish sizes of required equipment pads. Furnish and locate bolts and fittings required to be cast in them.
- D. Locate and size openings required for installation of work specified in this Division in sufficient time to prevent delay in the work.
- E. Refer to other Divisions of the specifications for the scope of required connections to equipment furnished under that Division. Determine from the Contractor for the various trades, the Owner, and by direction from the Architect/Engineer, the exact location of all items.

1.9 CONCEALED AND EXPOSED WORK

- A. When the word "concealed" is used in connection with insulating, painting, piping, ducts and the like, the work is understood to mean hidden from sight as in chases, furred spaces or above ceilings. "Exposed" is understood to mean open to view.

1.10 GUARANTEE

- A. Guarantee work for 1 year from the date of substantial completion of the project. During that period make good any faults or imperfections that may arise due to defects or omissions in material, equipment or workmanship. At the Owner's option, replacement of failed parts or equipment shall be provided.

1.11 MATERIAL AND EQUIPMENT

- A. Furnish new and unused materials and equipment meeting the requirements of the paragraph specifying acceptable manufacturers. Where two or more units of the same type or class of equipment are required, provide units of a single manufacturer.

1.12 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 building structure by equipment, piping, ducts or other parts of work, rectify such conditions at no additional cost. If the item of equipment is judged to produce objectionable noise or vibration, demonstrate at no additional cost that equipment performs within designated limits on a vibration chart.

1.13 ACCEPTABLE MANUFACTURERS

- A. Manufacturers names and catalog number specified under sections of Division 22 are used to establish standards of design, performance, quality and serviceability and not to limit competition. Equipment of similar design, equal to that specified, manufactured by a named manufacturer will be acceptable on approval. A request for prior approval of equipment not listed must be submitted ten (10) days before bid due date. Submit complete design and performance data to the Engineer.

1.14 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 operation throughout the range of operation. Tests shall be made in the presence of the Architect/Engineer. Make adjustments as required to ensure proper functioning of all

systems. Special tests on individual systems are specified under individual sections. Submit 3 copies of all certifications and test reports adequately in advance of completion of the work to allow for remedial action as required to correct deficiencies discovered in equipment and systems.

1.15 WARRANTIES

- A. Submit 3 copies of all warranties and guarantees for systems, equipment, devices and materials. These shall be included in the Operating and Maintenance Manuals.

1.16 BUILDING CONSTRUCTION

- A. It shall be the responsibility of each sub-contractor to consult the Architectural and Engineering drawings, details, and specifications and thoroughly familiarize himself with the project and all job related requirements. Each sub-contractor shall cooperate with the General Contractor to verify that all piping and other items are placed in the walls, furred spaces, chases, etc., so there will be no delays in the job.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1 OPENINGS

- A. Framed, cast or masonry openings for ductwork, equipment or piping are specified under other divisions. Drawings and layout work for exact size and location of all openings are included under this division.

3.2 HOUSEKEEPING PADS

- A. Provide equipment housekeeping pads under all floor mounted and ground mounted plumbing equipment, and as shown on the drawings.
- B. Concrete work as specified in Division 3.
- C. Concrete pads:
 - 1. 4" high, rounded edges, minimum 2500 psi unless otherwise indicated on the drawings
 - 2. Chamfer strips at edges and corner of forms.
 - 3. Smooth steel trowel finish.
 - 4. Doweled to existing slab
- D. Install concrete curbs around multiple pipe penetrations.

3.3 VANDAL RESISTANT DEVICES

- A. Provide a handle for each loose keyed operated valve and hose bibb on the project.
- B. Do not use vandal resistant screws or bolts on the project.
- C. Proof of delivery of these items to the Owner shall be included in the Operating and Maintenance Manuals.

3.4 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 plumbing 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 plumbing 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 Operating and Maintenance Manual.

3.5 EQUIPMENT IDENTIFICATION

- A. Provide a laminated engraved plastic nameplate on each piece of equipment and starter.
 - 1. Designation approved by Architect/Engineer.
 - 2. Equipment includes, but is not limited to, water heaters, pumps, boilers and utility controllers.
 - 3. Submit schedule of equipment to be included and designations.
- B. Provide nameplates with 1/2" high letters and fastened with epoxy or screws.

3.6 OBSTRUCTIONS

- A. The drawings indicate certain information pertaining to surface and subsurface obstructions which has been taken from available drawings. Such information is not guaranteed, however, as to accuracy of location or complete information.
 - 1. Before any cutting or trenching operations are begun, verify with Owner's representative, utility companies, municipalities, and other interested parties that all available information has been provided.
 - 2. Should obstruction be encountered, whether shown or not, alter routing of new work, reroute existing lines, remove obstruction where permitted, or otherwise perform whatever work is necessary to satisfy the purpose of the new work and leave existing services and structures in a satisfactory and serviceable condition.
- B. Assume total responsibility for and repair any damage to existing utilities or construction, whether or not such existing facilities are shown.

3.7 PROTECTION

- A. Protect work, equipment, fixtures, and materials. At work completion, work must be clean and in original manufacturer's condition.

END OF SECTION

SECTION 22 05 10 - PLUMBING CONTRACT QUALITY CONTROL

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Contract quality control including workmanship, manufacturer's instructions and demonstrations.

1.2 QUALITY CONTROL PROGRAM

- A. Maintain quality control over supervision, subcontractors, suppliers, manufacturers, products, services, site conditions and workmanship to produce work in accordance with contract documents.

1.3 WORKMANSHIP

- A. Comply with industry standards except when more restrictive tolerances or specified requirements indicate more rigid standards or more precise workmanship.
- B. Perform work by persons qualified to produce workmanship of specified quality.
- C. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, and racking. Under no conditions shall material or equipment be suspended from structural bridging.
- D. Provide finishes to match approved samples. All exposed finishes shall be approved by the Architect. Submit color samples as required.

1.4 MANUFACTURER'S INSTRUCTIONS

- A. Comply with instructions in full detail, including each step in sequence.
- B. Should instruction conflict with Contract Documents, request clarification from Architect / Engineer before proceeding.

1.5 MANUFACTURER'S CERTIFICATES

- A. When required in individual Specification Sections, submit manufacturer's certificate in duplicate, certifying that products meet or exceed specified requirements.

1.6 MANUFACTURER'S FIELD SERVICES

- A. When required in individual Specification Sections, manufacturer shall provide qualified personnel to observe:
 - 1. Field conditions.
 - 2. Condition of installation.
 - 3. Quality of workmanship.
 - 4. Start-up of equipment.
 - 5. Testing, adjusting, and balancing of equipment.
- B. Representative shall make written report of observations and recommendations to Architect / Engineer.

PART 2 - PRODUCTS

2.1 REFERENCE APPLICABLE SPECIFICATION SECTIONS.

PART 3 - EXECUTION

3.1 PROTECTION OF EQUIPMENT

- A. 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 a like kind at no additional cost to the Owner.
- B. Adequately protect equipment from damage after delivery to the project. Cover with heavy tarpaulins, drop cloths or other protective coverings as required to protect from plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion.

END OF SECTION

**SECTION 22 05 12 - PLUMBING SHOP DRAWINGS, COORDINATION DRAWINGS
& PRODUCT DATA**

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Prepare submittals as required by Division 1.
- B. The term submittal, as used herein, refers to all:
 - 1. Shop Drawings
 - 2. Coordination Drawings
 - 3. Product data
- C. Submittals shall be prepared and produced for:
 - 1. Distribution as specified
 - 2. Inclusion in the Operating and Maintenance Manual, as specified, in the related section

1.2 SHOP DRAWINGS

- A. Present drawings in a clear and thorough manner. Identify details by reference to sheet and detail, schedule, or room numbers shown on Contract Drawings.
- B. Show all dimensions of each item of equipment on a single composite Shop Drawing. Do not submit a series of drawings of components.
- C. Identify field dimensions; show relationship to adjacent features, critical features, work, or products.
- D. Submit shop drawings in plan, elevation and sections, showing equipment in mechanical equipment areas.

1.3 COORDINATION DRAWINGS

- A. Present in a clear and thorough manner. Title each drawing with project name. Identify each element of drawings by reference to sheet number and detail, or room number of contract documents. Minimum drawing scale: $\frac{1}{4}'' = 1'-0''$.
- B. Prepare coordination drawings to coordinate installations for efficient use of available space, for proper sequence of installation, and to resolve conflicts. Coordinate with work specified in other sections and other divisions of the specifications.
- C. For each mechanical room and for each outside equipment pad where equipment is located, submit plan and elevation drawings. Show:
 - 1. Actual mechanical equipment and components to be furnished
 - 2. Service clearance
 - 3. Relationship to other equipment and components
 - 4. Roof drains and leader piping
 - 5. Fire protection piping and equipment
- D. Identify field dimensions. Show relation to adjacent or critical features of work or products.
- E. Related requirements:
 - 1. Ductwork shop drawings

2. Coordination drawing specified in Division 26

- F. Submit shop drawings in plan, elevation and sections, showing equipment in mechanical equipment areas.
- G. Gas piping sketch indicating proposed location of piping prior to proceeding with the installation.

1.4 PRODUCT DATA AND INSTALLATION INSTRUCTION

- A. Submit only pages which are pertinent to the project. All options which are indicated on the product data shall become part of the contract and shall be required whether specified are not.
- B. Mark each copy of standard printed data to identify pertinent products, referenced to specification section and article number.
- C. Show reference standards, performance characteristics and capacities; wiring and piping diagrams and controls; component parts; finishes; dimensions and required clearances.
- D. Modify manufacturer's standard schematic drawings and diagrams to supplement standard information and to provide information specifically applicable to the work. Delete information not applicable.
- E. Mark up a copy of the specifications for the product. Indicate in the margin of each paragraph the following: "Comply, "Do Not Comply", or "Not Applicable". Explain all "Do Not Comply" statements.
- F. Provide a separate transmittal for each submittal item. Transmittals shall indicate product by specification section name and number. Separate all submittals into appropriate specification section number. Do not combine specification sections.

1.5 MANUFACTURERS INSTRUCTIONS

- A. Submit Manufacturer's instructions for storage, preparation, assembly, installation, start-up, adjusting, calibrating, balancing and finishing.

1.6 CONTRACTOR RESPONSIBILITIES

- A. Review submittals prior to transmittal.
- B. Determine and verify:
 - 1. Field measurements
 - 2. Field construction criteria
 - 3. Manufacturer's catalog numbers
 - 4. Conformance with requirements of Contract Documents
- C. Coordinate submittals with requirements of the work and of the Contract Documents.
- D. Notify the Architect/Engineer in writing at time of submission of any deviations in the submittals from requirements of the Contract Documents.
- E. Do not fabricate products, or begin work for which submittals are specified, until such submittals have been produced and bear contractor's stamp. Do not fabricate products or

begin work scheduled to have submittals reviewed until return of reviewed submittals with Architect/Engineer's acceptance.

- F. Contractor's responsibility for errors and omissions in submittals is not relieved whether Architect/Engineer reviews submittals or not.
- G. Contractor's responsibility for deviations in submittals from requirements of Contract Documents is not relieved whether Architect/Engineer reviews submittals or not, unless Architect/engineer gives written acceptance of the specific deviations on reviewed documents.
- H. Submittals shall show sufficient data to indicate complete compliance with Contract Documents:
 - 1. Proper sizes and capacities
 - 2. That the item will fit in the available space in a manner that will allow proper service
 - 3. Construction methods, materials and finishes
- I. Schedule submissions at least 15 days before date reviewed submittals will be needed.

1.7 SUBMISSION REQUIREMENTS

- A. Make submittals promptly in accordance with approved schedule, and in such sequence as to cause no delay in the Project or in the work of any other Contractor.
- B. Number of submittals required:
 - 1. Shop Drawings and Coordination Drawings: Submit one reproducible transparency and three opaque reproductions.
 - 2. Product Data: Submit the number of copies which the contractor requires, plus those which will be retained by the Architect/Engineer.
- C. Accompany submittals with transmittal letter, in duplicate, containing:
 - 1. Date
 - 2. Project title and number
 - 3. Contractor's name and address
 - 4. The number of each Shop Drawing, Project Datum and Sample submitted
 - 5. Other pertinent data
- D. Submittals shall include:
 - 1. The date of submission
 - 2. The project title and number
 - 3. Contract Identification
 - 4. The names of:
 - a. Contractor
 - b. Subcontractor
 - c. Supplier
 - d. Manufacturer
 - 5. Identification of the product
 - 6. Field dimensions, clearly identified as such
 - 7. Relation to adjacent or critical features of the work or materials
 - 8. Applicable standards, such as ASTM or federal specifications numbers
 - 9. Identification of deviations from contract documents
 - 10. Suitable blank space for General Contractor and Architect/Engineer stamps
 - 11. Contractor's signed and dated Stamp of Approval
- E. Coordinate submittals into logical groupings to facilitate interrelation of the several items:

1. Finishes which involve Architect/Engineer selection of colors, textures or patterns
2. Associated items which require correlation for efficient function or for installation

1.8 SUBMITTAL SPECIFICATION INFORMATION

- A. Every submittal document shall bear the following information as used in the project manual:
 1. The related specification section number
 2. The exact specification section title
- B. Submittals delivered to the Architect/Engineer without the specified information will not be processed. The Contractor shall bear the risk of all delays, as if no submittal had been delivered.

1.9 RESUBMISSION REQUIREMENTS

- A. Make re-submittals under procedures specified for initial submittals.
 1. Indicate that the document or sample is a re-submittal
 2. Identify changes made since previous submittals
- B. Indicate any changes which have been made, other than those requested by the Architect / Engineer.

1.10 CONTRACTOR'S STAMP OF APPROVAL

- A. Contractor shall stamp and sign each document certifying to the review of products, field measurements and field construction criteria, and coordination of the information within the submittal with requirements of the work and of Contract Documents.
- B. Contractor's stamp of approval on any submittal shall constitute a representation to Owner and Architect/Engineer that Contractor has either determined and verified all quantities, dimensions, field construction criteria, materials, catalog numbers, and similar data or assumes full responsibility for doing so, and that Contractor has reviewed or coordinated each submittal with the requirements of the work and the Contract Documents.
- C. Do not deliver any submittals to the Architect/Engineer that do not bear the Contractor's stamp of approval and signature.
- D. Submittals delivered to the Architect/Engineer without Contractor's stamp of approval and signature will not be processed. The Contractor shall bear the risk of all delays, as if no submittal had been delivered.

1.11 ARCHITECT/ENGINEER REVIEW OF IDENTIFIED SUBMITTALS

- A. The Architect/Engineer will:
 1. Review identified submittals with reasonable promptness and in accordance with schedule
 2. Affix stamp and initials or signature, and indicate requirements for re-submittal or approval of submittal
 3. Return submittals to Contractor for distribution or for resubmission
- B. Review and approval of submittals will not extend to design data reflected in submittals which is peculiarly within the special expertise of the Contractor or any party dealing directly with the Contractor.

- C. Architect/Engineer's review and approval is only for conformance with the design concept of the project and for compliance with the information given in the contract.
 - 1. The review shall not extend to means, methods, sequences, techniques or procedures of construction or to safety precautions or programs incident thereto.
 - 2. The review shall not extend to review of quantities, dimensions, weights or gauges, fabrication processes or coordination with the work of other trades.
- D. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.

1.12 SUBSTITUTIONS

- A. Do not make requests for substitution employing the procedures of this Section.
- B. The procedure for making a formal request for substitution is specified in Div. 1.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION

SECTION 22 05 13 - ELECTRICAL PROVISIONS OF PLUMBING WORK

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Electrical provisions to be provided as plumbing work are indicated in other Division 22 sections, on drawings, and as specified.
- B. Types of work, normally recognized as electrical but provided as plumbing, specified or partially specified in this Section, include but are not necessarily limited to the following:
 - 1. Motors for plumbing equipment.
 - 2. Starters for motors of plumbing equipment, but only where specifically indicated to be furnished integrally with equipment.
 - 3. Wiring from motors to disconnect switches or junction boxes for motors of plumbing equipment, but only where specifically indicated to be furnished integrally with equipment.
 - 4. Wiring of field-mounted float control switches, flow control switches, and similar plumbing-electrical devices provided for plumbing systems, to equipment control panels.
 - 5. Pipe heat tracing.
- C. Refer to Division 22 sections for specific individual plumbing equipment electrical requirements.
- D. Refer to Division 26 sections for motor starters and controls not furnished integrally with plumbing equipment.
- E. Refer to Division 26 sections for junction boxes and disconnect switches required for motors and other electrical units of plumbing equipment.

1.2 RELATED WORK

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Specification Sections, apply to work of this Section.

1.3 QUALITY ASSURANCE

- A. Wherever possible, match elements of electrical provisions of plumbing work with similar elements of electrical work specified in Division 26 sections for electrical work not otherwise specified.
- B. For electrical equipment and products, comply with applicable NEMA standards, and refer to NEMA standards for definitions of terminology. Comply with National Electrical Code (NFPA 70) for workmanship and installation requirements.

1.4 SUBMITTALS

- A. Include in listing of motors, voltage, notation of whether motor starter is furnished or installed integrally with motor or equipment containing motors.

PART 2 - PRODUCTS

2.1 MOTORS

- A. Provide motors for plumbing equipment manufactured by one of the following:
 - 1. Baldor Electric Company.
 - 2. Century Electric Div., Inc.
 - 3. General Electric Co.
 - 4. Louis Allis Div.; Litton Industrial Products, Inc.
 - 5. Lincoln Electric
 - 6. Marathon Electric Mfg. Corp.
 - 7. Reliance Electric Co.
 - 8. Westinghouse Electric Corp.
- B. Motor Characteristics. Except where more stringent requirements are indicated, and except where required items of plumbing equipment cannot be obtained with fully complying motors, comply with the following requirements for motors of plumbing work:
- C. Temperature Rating. Rated for 40°C environment with maximum 50°C temperature rise for continuous duty at full load (Class A Insulation).
- D. Provide each motor capable of making starts as frequently as indicated by automatic control system, and not less than 5 starts per hour for manually controlled motors.
- E. Phases and Current Characteristics. Provide squirrel-cage induction polyphase motors for 3/4hp and larger, and provide capacitor-start single-phase motors for 1/2hp and smaller, except 1/6hp and smaller may, at equipment manufacturer's option, be split-phase type. Coordinate current characteristics with power specified in Division 26 sections, and with individual equipment requirements specified in other Division 22 requirements. For 2-speed motors provide 2 separate windings on polyphase motors. Do not purchase motors until power characteristics available at locations of motors have been confirmed, and until rotation directions have been confirmed.
- F. Service Factor. 1.15 for polyphase motors and 1.35 for single-phase motors.
- G. Motor Construction. Provide general purpose, continuous duty motors, Design "B" except "C" where required for high starting torque.
 - 1. Frames. NEMA #56.
 - 2. Bearings are to be ball or roller bearings with inner and outer shaft seals, regreasable except permanently sealed where motor is inaccessible for regular maintenance. Where belt drives and other drives produce lateral or axial thrust in motor, provide bearings designed to resist thrust loading. Refer to individual section of Division 22 for fractional-hp light-duty motors where sleeve-type bearings are permitted.
 - 3. Except as indicated, provide open drip-proof motors for indoor use where satisfactorily housed or remotely located during operation, and provide guarded drip-proof motors where exposed to contact by employees or building occupants. Provide weather-protected Type I for outdoor use, Type II where not housed. Refer to individual sections of Division 22 for other enclosure requirements.
 - 4. Provide built-in thermal overload protection and, where indicated, provide internal sensing device suitable for signaling and stopping motor at starter.
 - 5. Noise Rating: Provide "Quiet" rating on motors.
- H. All motors shall be premium efficiency.

2.2 EQUIPMENT FABRICATION

- A. Fabricate plumbing equipment for secure mounting of motors and other electrical items included in work. Provide either permanent alignment of motors with equipment, or

adjustable mountings as applicable for belt drives, gear drives, special couplings and similar indirect coupling of equipment. Provide safe, secure, durable, and removable guards for motor drives. Arrange for lubrication and similar running-maintenance without removal of guards.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install motors on motor mounting systems in accordance with motor manufacturer's instructions, anchored to resist torque, drive thrusts, and other external forces inherent in plumbing work. Secure sheaves and other drive units to motor shafts with keys and Allen set screws on flat surface of shaft. Unless otherwise indicated, set motor shafts parallel with machine shafts.
- B. Verify voltage with Electrical Plans.

END OF SECTION

SECTION 22 05 14 - PLUMBING ALTERATIONS PROJECT PROCEDURES

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Inspect and service existing equipment and materials that are to remain or to be reused.
- B. Disposal of equipment, materials, or housekeeping pads to be abandoned. Prior to disposal, the Contractor shall verify with the Owner what is to be salvaged by the Owner and what is to become the property of the Contractor.
- C. Handling of equipment and materials to be removed.

1.2 QUALITY ASSURANCE

- A. Coordination with the Owner prior to the disconnection or shutdown of existing equipment, or to the modification of existing operational systems.

1.3 CONTRACT DRAWINGS

- A. There is the possibility that existing conditions and devices are affected by the work indicated on the drawings and called for in the specifications (project manual) that do not appear on the drawings. It is the Contractor's responsibility to visit the site and determine all of the existing conditions and to consider these existing conditions when making and presenting a proposal, to have a complete proposal.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Material used to upgrade and repair existing equipment shall conform to that specified.
- B. Material used to upgrade and repair existing equipment shall not void existing warranties or listings of the equipment to be upgraded or repaired.
- C. Material used to upgrade and repair existing equipment shall be new and shall be of the same manufacturer of the existing equipment, shall be acquired through the existing original equipment manufacturer's approved distribution channels, shall have manufacturer's warranties for the new material being used, and shall be listed for the use intended.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Existing materials and equipment indicated on the drawings or in the specifications to be reused shall be inspected for damaged or missing parts. Contractor shall notify the Architect/Engineer, in writing, accordingly.
- B. If using materials specified or shown on the drawing voids or diminishes the warranty or operation of remaining equipment or systems, the Contractor shall notify the Architect/Engineer, in writing.
- C. Verify field measurements, above and underground piping connections and flows.

- D. Demolition Drawings are based on casual field observation, and when available, existing record documents. Report discrepancies to Architect before disturbing existing installation, and immediately after such discrepancies are discovered.
- E. Field verify existing conditions and actual utility uses prior to final connections. Existing drawings may not have been available for all required information. Use pipe inspection camera system to field verify existing sanitary / grease waste connections. Verify flow direction and depth prior to connection to existing plumbing systems.

3.2 APPLICATION

- A. Existing materials and equipment indicated on the drawings or in the specifications to be reused shall be cleaned and reconditioned, including cleaning of piping systems prior to installation and reuse.
- B. Material and equipment removed that is not to be salvaged for Owner's use or for reuse on the project shall become the property of the Contractor and be removed from the site.
- C. Material or equipment salvaged for Owner's use shall be carefully handled and stored where directed by the Owner or the Architect / Engineer. Relocate material and / or equipment as directed by Owner.
- D. Materials and equipment not indicated to be removed or abandoned shall be reconnected to the new system.
- E. Materials, equipment and housekeeping pads not to be reused or reconnected shall be removed for Owner's review and salvaged by Contractor.
- F. Prior to start of construction, Contractor shall walk areas to be renovated with Owner to identify and document items to be salvaged for Owner's use.
- G. Clean and repair existing materials and equipment that remain or are to be reused.
- H. Contractor shall utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

3.3 SEQUENCE AND SCHEDULE

- A. Coordinate utility service outages with Utility Company, Architect and Owner.
- B. Provide additional or temporary valves, piping and connections to maintain existing systems in service during construction.
- C. Existing Plumbing Service: Refer to drawings for work in remodeled areas. Where facilities in these areas are to remain in service, any related work to keep the facilities in operation is specified in this Division. Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Obtain permission from Owner at least 48 hours before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area. Maintain acceptable temperature and humidity control within existing building during renovation activities.
- D. Remove and replace existing Plumbing systems and appurtenances as occasioned by new or remodeled construction. Re-establish service that may be interrupted by

remodeled construction.

- E. Refer to other drawings series for work in remodeled areas. Where facilities in these areas are required to remain in service, any related work required to keep these facilities in operation is specified in this Division.
- F. Remove and replace existing piping coincident with the construction.
- G. Remove or relocate existing piping or housekeeping pads as occasioned by new or remodeled construction. Cap unused domestic piping beyond the new finish line.
- H. Relocate all domestic piping as required to accommodate new work requiring precedence.
- I. Remove concrete housekeeping pad where materials or equipment have been removed.
- J. Remove all known utilities that do not provide service to the buildings that remain.
- K. Remove existing plumbing vent penetrations through roof not to be reused. During demolition, abandoned plumbing vents are to be removed in their entirety. Do not cap the vent pipes below the roof deck and abandon in place. The hole in the roof is to be patched and made water tight.

3.4 DEMOLITION AND EXTENSION OF EXISTING PLUMBING WORK

- A. The Contractor shall modify, remove, and/or 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 the property of the Owner, and shall be delivered to such destination as directed by the Owner's representative unless they are not wanted, then it will be the responsibility of this Contractor to remove such items and properly dispose of them. Materials and/or items scheduled for relocation and which are damaged during dismantling or reassembly operations shall be repaired and restored to good operative condition. The Contractor may, at his discretion, and upon approval of the Owner's representative substitute new materials and/or items of like design and quality in lieu of materials and/or items to be relocated.
- B. All items 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 relocations and to restore them 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.
- C. When items scheduled for relocation and/or reuse are found to be in damaged condition before work has been started on dismantling, the Contractor shall call the attention of the Owner's representative to such items and receive further instructions before removal. Items damaged in repositioning operations are the contractor's responsibility and shall be repaired or replaced by the contractor as approved by the owner's representative, at no additional cost to the Owner.
- D. Plumbing, piping and appurtenances to be removed, salvaged, or relocated shall be removed to points indicated on the drawings, specified, or acceptable to the Owner's representative. Piping 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 disconnected in a safe manner acceptable to the Construction

Inspector. All disconnections or connections into the existing facilities shall be done in such a manner as to result in minimum interruption of services to adjacent occupied areas. Services to existing areas or facilities that must remain in operation during the construction period shall not be interrupted without prior specific approval of the Owner's representative hereinbefore specified.

- E. Repair adjacent construction and finishes damaged during demolition and extension work.
- F. Maintain access to mechanical installations that remain active. Modify installation or provide access panel as appropriate.
- G. Extend existing installations using materials and methods compatible with existing plumbing installations, or as specified.
- H. Existing plumbing piping and devices found to need additional hangers installed should be added at no additional cost to the Owner.

3.5 PROTECTION OF THE WORK

- A. Provide adequate temporary support and auxiliary structure as necessary to ensure structural value or integrity of affected portion of work.
- B. Provide devices and methods to protect other portions of work from damage.
- C. Execute fitting and adjustment of products to provide a finished installation to comply with specified products, functions, tolerances and finishes.

3.6 IDENTIFICATION OF EQUIPMENT IN RENOVATED AREAS

- A. Identification of Equipment: Provide new identification of all existing equipment to be reused and located within the renovated areas. Do not include the description "existing". Provide new nameplates for all existing plumbing equipment in renovated areas as specified in Section 22 05 00 Plumbing General Provisions.

END OF SECTION

SECTION 22 05 15 - PLUMBING EARTHWORK

PART 1 - GENERAL

- A. Excavate and backfill for pipe trenches for underground piping, and excavate for structures installed as part of plumbing work.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 EXCAVATION

- A. Excavate trenches for underground piping to the required depth to ensure 2 foot minimum coverage over piping.
- B. Cut the bottom of the trench or excavation to uniform grade.
- C. Should rock be encountered, excavate 6 inches below grade, fill with bedding material and tamp well.
- D. 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.

3.2 BACKFILL

- A. 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.
- B. 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 8 inch maximum layers, loose measure. Compact to not less than 95% of maximum soil density as determined by ASTM D-698 Standard Proctor.
- C. 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.

3.3 DISPOSAL OF EXCESS MATERIAL

- A. 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 the Owner / Architect.

END OF SECTION

**SECTION 22 05 16 - EXCAVATING, BACKFILLING AND
COMPACTING FOR UTILITIES**

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 apply to this section.
- B. Refer to Instructions to Bidders for substitution of materials and products.
- C. Addenda issued during the bidding period that affect this section of the specifications.

1.2 WORK INCLUDED

- A. Coordinating all excavating and backfilling for the underground storm sewer, sanitary sewer, water distribution lines, and all related appurtenances.
- B. The extent of lines, excavation, and backfill shall be in conformance with the locations, lines, elevations and grades shown on the drawings prepared by the MEP Engineer.

1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS

- A. Earthwork
- B. Water Distribution
- C. Sanitary Sewer
- D. Plumbing

1.4 REFERENCES

- A. American Society for Testing and Materials (ASTM) Use current edition.
 - 1. ASTM D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³)
 - 2. ASTM D1556, Standard Test method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
 - 3. ASTM D4253, Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table
 - 4. ASTM D4254, Standard Test Method for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density
- B. City Standards
- C. Local Governing Agencies
- D. Texas Health and Safety Code, Chapter 161, Subchapter Q, as amended by House Bill No. 1927.

1.5 WARRANTY

- A. Provide written warranty against defects in the material and workmanship for the work of this Section for a period of one year from the Date of Substantial Completion of the Project. Refer to Division 1 for Warranty form.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Sand: Clean, local sand
- B. Earth Backfill: Clean local material consistent with the surrounding earth material and free of large clods, roots, rocks or other debris.

PART 3 – EXECUTION

3.1 EXCAVATION

- A. General:
 - 1. All utility trenches shall be constructed in conformance with OSHA trench safety standards.
 - 2. Sheet piling and shoring shall be accomplished to the extent necessary to maintain the sides of the trench in a vertical position throughout the construction period for trenches five feet in depth or deeper. Where approved, trench sides may be laid back in lieu of shoring to meet OSHA safety standards.
 - 3. Utilities shall not be constructed or laid in a trench in the presence of water. All water shall be sufficiently removed from the trench prior to the line placing operation to ensure a dry, firm bed on which to place the utility line.
- B. Storm and Sanitary Sewer Trenches:
 - 1. For pipe sizes less than 42 inches in diameter, the minimum trench width shall be outside diameter of pipe plus 18 inches.
 - 2. Trenches shall be excavated to a depth of at least 6 inches below the barrel of pipe.
- C. Appurtenances:
 - 1. Any overdepth excavation below appurtenances shall be refilled with compacted select fill or bank sand.
- D. Water Line Trenches:
 - 1. Water lines shall be at least two feet in depth from the top of proposed grade to the top of pipe.
 - 2. Trench width for water lines shall be a minimum of the outside pipe diameter plus 18 inches.
 - 3. Trenches shall be excavated to a depth of at least 6 inches below the barrel of pipe.

3.2 PIPE BEDDING AND BACKFILL – BELOW BUILDING SLAB

- A. Storm and Sanitary Sewer Trenches:
 - 1. Bedding, sewer pipe, and initial backfill over the pipe must be placed in a single day for any given portion of pipe. Initial backfill consisting of bank sand or select backfill shall be placed to one foot above the top of pipe for standard earth backfill.
 - 2. Remainder of trench backfill shall be placed the next day or later in 8 inch lifts.

3. Backfill shall be placed in uniform layers not to exceed 8 inches loose measured depth, and compacted to a minimum of 95% of Standard Maximum Density (ASTM D698).
- B. Water Line Trenches Below Building Slab/Outside Building Slab:
1. Pipe bedding shall consist of 6 inches of clean sand placed before the pipe is laid.
 2. After laying pipe and ensuring that the pipe is properly placed and supported by the sand bedding, clean sand backfill shall be placed to 6 inches above the top of pipe. The sand backfill shall be thoroughly rodded and tamped for compaction.
 3. For water lines to be beneath the building and pavement and to one foot from the outer edge of pavement, the remainder of the trench backfill shall be clean sand placed in 6 inch lifts and compacted to 95% Standard Proctor.
 4. For water lines not beneath the building and pavement or within one foot from the outer edge of pavement the remainder of the trench backfill shall be earth fill placed in uniform layers not to exceed 8" loose depth. Each lift shall be compacted to a minimum of 90% of Standard Density (ASTM D698) at the proper moisture content specified in the soils report for this project. All earth backfill shall be placed the next day or later after the pipe is laid.
 5. Backfill, under pavement and to one foot from outer edge, up to one foot below subgrade elevation. Remainder of backfill to subgrade to be as specified in paragraph 4 above.

3.3 PIPE BEDDING AND BACKFILL – OUTSIDE BUILDING SLAB

- A. Storm and Sanitary Sewer Trenches:
1. Bedding, sewer pipe, and initial backfill over the pipe must be placed in a single day for any given portion of pipe. Initial backfill consisting of bank sand or select backfill shall be placed to one foot above the top of pipe for standard earth backfill.
 2. Remainder of trench backfill shall be placed the next day or later in 8 inch lifts.
 3. Backfill shall be placed in uniform layers not to exceed 8 inches loose measured depth, and compacted to a minimum of 95% of Standard Maximum Density (ASTM D698).
 4. Backfill, under pavement and to one foot from outer edge, up to one foot below subgrade elevation. Remainder of backfill to subgrade to be as specified in paragraph 3 above.

3.4 NATURAL GAS PIPING

- A. Natural Gas Trenches:
1. Natural gas lines shall not be installed under slabs on grade unless pipes are sleeved and vented as per Section 22 63 11.
 2. Natural gas lines shall not be installed in trenches with other utilities.
- B. Utility Locators:
1. Provide metallic locator over all non-metallic gas piping utilities. Locator tape shall be a maximum of 12 inches below grade and centered over the utility(s).

END OF SECTION

SECTION 22 05 17 - PLUMBING ACCESS DOORS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish and install access doors in wall or ceiling locations as required or shown for access to valves, controls, regulating devices, water arresters and other equipment requiring maintenance, adjustment or operation.

PART 2 - PRODUCTS

2.1 NON-FIRE RATED ACCESS DOORS

- A. 16-Gauge frames
- B. 14-gauge steel panels
- C. Continuous fully concealed hinges
- D. Flush screwdriver cam lock for Owner selection
- E. Prime coat finish
- F. Brushed satin stainless steel finish for restroom, kitchen or cafeteria installation
- G. Material suitable for wall and/or ceiling mounting

2.2 FIRE RATED ACCESS DOORS

- A. UL listed, 1-1/2 hour Label "B", access doors
- B. 16-Gauge stainless steel
- C. 20-Gauge insulated sandwich-type door panel.
- D. Two inch thick with fire rated insulation
- E. Continuous fully concealed hinge
- F. Automatic closing and latching mechanism
- G. Knurled knob and recessed key operation for Owner selection
- H. Interior latch release slide for opening from inside
- I. Prime coat finish
- J. Material suitable for wall and/or ceiling mounting

2.3 ACCEPTABLE MANUFACTURERS

- A. Milcor
- B. MIFAB

C. Acudor

D. Elmdor

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Access doors specified in Division 22 will be installed by other crafts. Not all required access doors are shown. Coordinate with the Contractor to locate access doors for ease of operation and maintenance of concealed equipment.
- B. Installation shall be in accordance with the manufacturer's printed instructions.
- C. Minimum size required:
 - 1. 24" x 24" for plumbing multiple isolation valves and electrical related items in ceilings
 - 2. 8"x8" for plumbing for single isolation valve or shock arrestor

END OF SECTION

SECTION 22 05 19 - PRESSURE AND TEMPERATURE INSTRUMENTS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. This section specifies gauges, thermometers, wells and/or pressure and temperature test stations to be installed as specified.

1.2 RELATED WORK

- A. Division 22, Plumbing
 - 1. Plumbing General Provisions
 - 2. Pipe and Pipe Fittings, General
 - 3. Valves, Strainers and Vents

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS - GAUGES AND THERMOMETERS

- A. Trerice
- B. Taylor
- C. Marsh
- D. Weksler
- E. Marshalltown
- F. Weiss
- G. Miljoco

2.2 PRESSURE GAUGES

- A. Case and Ring: 4" type 304 stainless steel; liquid filled case with stainless steel bayonet ring.
- B. Dial: White aluminum with black markings
- C. Window: Clear acrylic
- D. Tube: Phosphor bronze and forged brass socket.
- E. Gauge accuracy: +/- 1% over operating range.
- F. For pulsating service, provide impulse dampers.
- G. Without flange for pipe mounting.
- H. With flange for wall mounting.
- I. Weiss Model: Domestic Water 4CTSLF (Lead Free) 0-100 PSI

2.3 THERMOMETER WELLS

- A. Brass or type 300 stainless steel. Machined bar stock, 1-piece construction (Lead Free).
- B. Where installed in insulated piping or vessels, provide with extension neck to match insulation thickness.
- C. Provide metal-to-metal contact with bulb chamber for maximum sensitivity.
- D. Wells shall be sized to extend a minimum of 50% into pipe.

2.4 THERMOMETERS IN PIPING SYSTEMS OR VESSELS

- A. Die cast aluminum case with baked epoxy finish.
- B. Adjustable angle 9" scale length.
- C. Clear acrylic window.
- D. Brass stem, length to match well.
- E. Red reading organic spirit filled-in magnifying glass column.
- F. White background with black figures and markings.
- G. Brass stems and union connections (Lead Free).
- H. Accuracy: +/- 1% of scale range.
- I. Range:
 - 1. Hot water lines: 30°F to 240°F.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with drawing details and manufacturer's recommendations.
- B. Provide a ball valve at each gauge (Lead Free).
- C. Locate gauges and thermometers to be easily readable from the floor at a 5'-6" eye level. Use adjustable angle or rigid stem as required. Install gauges in upright position.
- D. Install gauges in the following locations: across pumps, storage tanks, heat exchangers.
- E. Install thermometer in the following locations: At storage tanks, across heat exchangers, across boiler, leaving side of water heater, leaving water side of tempered water valves, and hot water supply and return lines.
 - 1. Hot water lines: 30°F to 240°F.
 - 2. Tempered water valves 0°F to 120°F.

END OF SECTION

SECTION 22 05 23 - VALVES, STRAINERS AND VENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Plumbing Valves
- B. Pipe strainer and suction diffusers.

PART 2 - PRODUCTS

2.1 VALVES

- A. Pressure Ratings:
 - 1. Unless otherwise indicated, use valves suitable for 125 minimum psig working steam pressure (WSP) and 450°F.
 - 2. The pressure temperature rating of valves shall be not less than the design criteria applicable to components of the system.
 - 3. Use grooved butterfly valves when using grooved piping.
- B. Butterfly Valves
 - 1. Butterfly valves shall conform to MSS-SP67.
 - 2. Valves shall have a full lug type body designed for installation between ANSI standard flanges, and shall be rated at full working pressure with downstream flange removed.
 - 3. All valves for domestic use must be lead free.
 - 4. Do not use Victaulic flanges on butterfly valves.
 - 5. All butterfly valves shall have a stainless steel disc.
- C. Ball Valves
 - 1. Provide ball valves with:
 - a. Blowout proof stem.
 - b. Full size port, 316 stainless steel ball and stem.
 - c. Cast bronze body.
 - d. Threaded ends.
 - 2. Seat, seals, thrust washers and packing shall be suitable for the intended service.
 - 3. Service rating:
 - a. 150 psi saturated steam.
 - b. 600 psi WOG.
 - 4. Provide with memory stop for balancing valves.
 - 5. Where Viega ProPress fittings are used, Viega ProPress ball valves may be used, or as approved.
 - 6. All valves for domestic use must be lead free.
 - 7. Do not use PVC or CPVC ball valves.
- D. Valve Connections
 - 1. Provide valves suitable to connect to adjoining piping as specified for pipe joints. Use pipe size valves. Sweated joints are not allowed.
 - 2. Thread pipe sizes 2" and smaller.
 - 3. Flange pipe sizes 2-1/2" and larger.
 - 4. Use screw to solder adapters for copper tubing.
 - 5. Use grooved body valves with mechanical grooved jointed piping.
 - 6. Use press valves when using copper press systems.

- E. Valve Operators
1. Provide suitable hand-wheels for gate, globe, angle or drain valves and inside hose bibbs.
 2. When cocks and valves are furnished with square head stem:
 - a. Provide one wrench for every ten cocks or valves sized 2" and smaller, minimum of two.
 - b. Provide each cock or valve size 2-1/2" and larger with a wrench with setscrew.
 3. Where butterfly valves are provided:
 - a. Provide gear operators on valves 6" and larger.
 - b. Where valves are located 7' or more above the finished floor in equipment room areas provide chain-operated sheaves. Extend chains to about 5' above floor and hook to clips, arrange to clear walking space.
 - c. Lever lock handle with toothed plate for shut-off service and infinitely adjustable handle with lock and nut and memory stop for throttling service on valves 4" and smaller.
 - d. All butterfly valves shall have a stainless steel disc.
- F. Acceptable Manufacturers (All listed must be lead free);
1. Stockham
 2. Dezurik
 3. Crane
 4. Nibco
 5. Keystone
 6. Jenkins
 7. Kitz
 8. Apollo
 9. Milwaukee Valve
- G. Check Valves:
1. Bronze body, 2" and smaller, bronze disc (Teflon disc for steam service), regrinding swing check, screw-in cap, threaded connection.
 2. Iron body, 2-1/2" and larger, bronze trim, non-slam: stainless steel pins and springs, and bronze plate or bronze mounted, regrind-renew check, bronze seat ring and disc. Provide either wafer or threaded lug.
 3. Acceptable Manufacturers (All listed must be lead free):
 - a. Mission Duocheck
 - b. Nibco
 - c. Keystone
 - d. Kitz
 - e. Apollo
- H. Backflow Preventer (All valves for domestic use must be lead free):
1. BFP-1 (2" and smaller) bronze body, reduced pressure zone type with two inline independent check valves with an intermediate relief valve, complete with two full port ball valve shut-offs and ball type test cocks. Bronze strainer on inlet. Provide air gap fitting with full size drain piped to nearest floor drain. Watts 909-QT-S-LF.
 2. BFP-2 (2-1/2" and larger) stainless steel reduced pressure zone type with two inline independent check valves with reverse relief valves, two non-rising stem resilient sealed gate valves, cast iron strainer on inlet. Provide air gap fitting piped full size to nearest floor drain. Apollo RP4ALF-YS.
- I. Provide valves of same manufacturer throughout where possible.

- J. Provide valves with manufacturer's name and manufacturing location, duty and pressure rating clearly marked on outside of body.
- K. Where valves are installed in insulated piping, provide with extended neck so valve operator and stop plate clears the full thickness insulation.
- L. Provide valve, seat and trim materials suitable for the intended service.
- M. Provide memory stops for all valves used for throttling service. Valves for throttling service shall be butterfly, plug, globe or ball type.
- N. Float Valve
 - 1. On – Off non-modulating action
 - 2. Fully adjustable high and low level settings
 - 3. Float, float linkage and float rod
 - 4. Complete stainless steel material
 - 5. Level differential adjustment minimum to 18" maximum
 - 6. Stilling well
 - 7. Acceptable Manufacturer: CLA-VAL

2.2 PIPE SYSTEMS STRAINERS

- A. Body:
 - 1. Bronze "Y" pattern or basket as shown on the drawings.
 - 2. Line size.
 - 3. Threaded strainer blow down port.
 - 4. ASTM A #126 Class B Cast Iron Body.
- B. Construction:
 - 1. 2" size and smaller with screw connections rated 400 psi WOG.
 - 2. Over 2" size with flanged connections, rated 125 psi WOG.
- C. Fabricate screens of Monel or type 304 stainless steel:
 - 1. With 20 mesh woven wire in piping systems through 2".
 - 2. With 0.045 perforations in piping systems 2-1/2" and 3".
 - 3. With 0.125 perforations in piping systems 4" and larger.
- D. Start-up:
 - 1. Provide an additional fine mesh disposable screen for use during start-up operations.
 - 2. Remove after 30 days.
 - 3. Attach to piping for Owner's review.
- E. Acceptable Manufacturers (All listed must be lead free):
 - 1. Apollo
 - 2. Crane
 - 3. Keckley
 - 4. Kitz
 - 5. McAlear
 - 6. Mueller
 - 7. Muesco
 - 8. Nibco
 - 9. Zurn

2.3 VALVE SCHEDULE

- A. Domestic Service
 - 1. Gas shut-off service: UL approved for natural gas service.
 - a. Nibco Ball Valve, full port through 1": T-585-70-UL
 - b. Nibco Ball Valve conventional port 1-1/4" through 3": T-580-70-UL
 - c. Resun 2-1/2" and larger: 143 - 1-UL
 - d. DeZurick 2-1/2" and larger: Series 425 or 435
 - e. Locking Type: Rockford 3/4" and 1" PNP-400
Mueller 1-1/4" through 4": Lub-O-seal
 - f. Conbraco Ball Valve, full port through 4": 64-100 Series
 - h. Milwaukee Full Port 1/4"-2" #8303A
 - i. Milwaukee Standard Port 2-1/2" & 3" #8503
 - j. Kitz Full Port 2" =- #68
 - k. Apollo
 - 2. Cold and Hot water service (all listed must be Lead Free):
 - a. Nibco Ball Valve full port through 2": T-585-66-LF
 - b. Nibco Butterfly Valve 2-1/2" and larger: LD-2000 EDPM Gaskets
 - c. Watts Ball Valve 4" and larger: G-4000-FDA
 - d. Viega ProPress Bronze Ball Valves (where Viega ProPress fittings are used)
 - e. Kitz Full Port through 2" - #868M Lead Free
 - f. Milwaukee Full Port 1/4"-2" #8303A
 - g. Milwaukee Standard Port 2-1/2" & 3" #8503
 - h. Apollo Full Port to 3-1/2" 77CALF
 - i. Apollo Conventional Port 2-1/2"=3" 7OLF
 - 3. Check Valve (All listed must be Lead Free):
 - a. Nibco Check Valve: T - 413 – Y -LF (Teflon Seats)
 - b. Nibco Check Valve 2-1/2" and larger: F - 918 – Y -LF (Buna-N Disc)
 - c. Nibco Check Valve 2-1/2" and larger: W - 920 -W-LF (Wafer)
 - d. Kitz Y & Check: A-22T
 - e. Kitz 2-1/2" and Larger #778 C.I.
 - f. Kitz Wafer Check 2-1/2" and Larger #7032
 - g. Apollo Check Valve 163 TLF
 - h. Apollo Check Valve 2-1/2" – Larger 910 FLF

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install valves with stems upright or horizontal, not inverted.
- B. Install valves for shut-off and isolating service at each piece of equipment, at vertical risers, and where shown on the drawings.
- C. Use butterfly valves and ball valves in domestic hot water and domestic cold water systems interchangeable in place of gate and globe valves.
- D. Use butterfly valves and ball valves in circulating water systems, for balancing duty.
- E. Provide drain valves at main shut-off valves and low points of piping and apparatus so the systems can be entirely drained.
 - 1. 1" valve for pipes 6" and larger.
 - 2. 3/4" valve for pipes smaller than 6".
 - 3. Terminate with pipe plug.
 - 4. Drain valves shall be ball valves.

- F. Provide isolation valves in domestic water lines to isolate all equipment, restrooms, hose bibbs, and where shown on the drawings.
- G. Where valves are installed in insulated pipe, valve operator shall have an insert so the lever or handle will not damage the insulation. Install handles so the lever or handles will not damage the insulation.
- H. Provide clearance for installation of insulation and access to valves.
- I. Provide access where valves are not exposed.

3.2 VALVE TAGS

- A. Furnish valves with 1-1/2" diameter brass valve tags with stamped, black or red-filled numbers. Service designations shall be 1/4" letters, and valve numbers shall be 2" letters. Engineer shall approve Service designations. Secure tags to valves by use of brass "S" hooks or brass chain. Secure chain to valve by use of copper or Monel meter seals. Valve tags are not required if the valve is located within 3' of the equipment being served and the service is obvious.
- B. Mount charts and drawings listing functions of each valve and its location in a metal and glass frame. Place charts and drawings as directed; in addition, on the record drawings mark the symbols and furnish a valve schedule properly identifying the valve number, service, exact location, the material being piped, and the room number of area that the valve services. This schedule shall be furnished on reproducible drafting paper or film suitable for reproduction on an Ozalid machine. The Owner shall approve the size of drafting paper. Provide a copy of the valve chart in the Operating and Maintenance Manuals.

3.3 PIPE SYSTEMS STRAINERS

- A. Provide strainers in supply piping to circulating pumps, thermostatic mixing valves, before solenoid valves and trap primer valves.

END OF SECTION

SECTION 22 07 19 - PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish and install piping insulation, jackets, accessories and covering of specified materials. The insulation shall be used for high and low temperature piping applications including domestic hot and cold water, roof and overflow drain sump bodies and rain leaders, horizontal sanitary drain piping which receives condensate, make-up water and pool heating water.

1.2 QUALITY ASSURANCE

- A. The intent of insulation specifications is to obtain superior quality workmanship resulting in an installation that is absolutely satisfactory in both function and appearance. Provide insulation in accordance with the specifications for each type of service and apply as recommended by the manufacturer and as specified.
- B. An approved contractor for this work under this Division shall be:
 - 1. A specialist in this field and have the personnel, experience, training, skill, and the 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.
- C. All piping insulation used on the project inside the building must have a flame spread rating not exceeding 25 and a smoke developed rating not exceeding 50, as determined by test procedures ASTM E 84, NFPA 255 and UL 723. These ratings must be as tested on the composite of insulation, jacket or facing, and adhesive. Components such as adhesives, mastics and cements must meet the same individual ratings as the minimum requirements and bear the UL label.
- D. Condensation on any insulated piping system is not acceptable.
- E. Replace insulation damaged by either moisture or other means. Insulation that has been wet, whether dried or not, is considered damaged. Make repairs where condensation is caused by improper installation of insulation. Also repair any damage caused by the condensation.
- F. Where existing insulated piping, or other surfaces are tapped, remove existing insulation back to undamaged sections for hot surfaces or to nearest insulation stop for cold surfaces, and replace with new insulation of the same type and thickness as existing insulation. Apply as specified for insulation of the same service.

1.3 APPROVALS

- A. Submit product data on each insulation type, adhesive, and finish to be used in the work. Make the submittal as specified in Division 1 General Requirements and obtain approval before beginning installation. Include product description, list of materials and thickness for each service and location and the manufacturer's installation instructions for each product.
- B. Make a field application of each type of insulation to display the material, quality and application method. Obtain approval of the sample application before proceeding with installation of the work.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Glass fiber pipe insulation:
 - 1. Johns-Manville Micro-Lok AP-T
 - 2. Owens-Corning ASJ/SSL
 - 3. Knauf ASJ/SSL
- B. Cellular Glass Insulation (Foamglass):
 - 1. Pittsburg Corning
 - 2. Cell-U-Foam
- C. Aluminum Jacketing:
 - 1. Childers
 - 2. Pabco
 - 3. RPR
- D. Fiberglass reinforcing cloth mesh:
 - 1. Perma Glass Mesh
 - 2. Alpha Glass Mesh
 - 3. Childers Chil-Glas
 - 4. Vimasco
- E. Mastics and Adhesives
 - 1. Childers
 - 2. Foster
 - 3. Vimasco
 - 4. Armstrong 520 Adhesive
- F. Elastomeric Insulation
 - 1. Armacell
- G. Weather Resistant Coating
 - 1. WB Armaflex Finish
- H. Glass fiber blanket insulation
 - 1. Manville R-series Microlite FSKL
 - 2. Owens-Corning eD75 or ED100 RKF
 - 3. Knauf 0.75 PCF FSK

2.2 FIBERGLASS PIPE INSULATION

- A. Heavy density, dual temperature fiberglass insulation with factory applied, all service, reinforced vapor barrier jacket having integral laminated vapor barrier. Provide with a factory applied pressure sensitive tape closure system and matching butt strips. Supply in thickness as shown.
 - 1. Thermal conductivity 0.23 @ 75°F mean (ASTM 335).

2.3 ELASTOMERIC INSULATION

- A. Insulation material shall be flexible, closed-cell elastomeric insulation in tubular or sheet form. Material shall have a flame spread rating of 25 or less and a smoke developed rating of 50 or less when tested in accordance with ASTM E84, latest revision. Sheet material with a thickness greater than $\frac{3}{4}$ " shall have a flame spread rating of 25 or less and a smoke developed rating of 100 or less when tested in accordance with ASTM E84, latest revision. In addition, the product, when tested, shall not melt or drip flaming particles, and the flame shall

not be progressive. In addition, all materials shall pass simulated end-use fire test. Minimum $\frac{3}{4}$ " thick.

1. Thermal conductivity 0.27 at 75°F mean (ASTM C177 or C518)

2.4 CELLULAR GLASS INSULATION

A. ASTM C552:

1. "k" value of 0.35 @ 75°F ("ksi" value of 0.047 @ 24°C);
2. 8.0 lb/cu.ft. (128 kg/cu.m.) density

2.5 INSULATION/SHIELD AT HANGERS

- A. Field fabricated: Use 360° sections of rigid foamglass insulation that will support the bearing area at hangers and supports. Further support insulation at hangers and supports with a shield of galvanized metal covering at least half of the pipe circumference, and conforming to the schedule. Insulation shall extend at least 1" beyond metal shield on each end. When pipe is guided at top and bottom, metal shields shall cover the whole pipe circumference. Adhere metal shield to insulation so that metal will not slide with respect to insulation with $\frac{1}{2}$ " aluminum bands (2) per shield.
1. Sections of foam glass insulation may be used of the same outside diameter of the adjoining pipe insulation.
 2. Minimum thickness of foam glass insulation shall not be less than 1" thick.
- B. Pipe saddles: Formed galvanized sheets at each support point for insulated pipe, shaped to fit pipe, and covering bottom half of pipe. Length at saddle shall be not less than twice the insulation outside diameter or more than 22". Provide 18 gauge through 4" pipe and 16-gauge 5" pipe and above.

2.6 SEALANT, ADHESIVE AND FINISH

- A. Lap Adhesive. Provide Childers CP-82 adhesive.
- B. Vapor Barrier Finish:
1. Indoors: Provide as insulation coating Childers CP-35, white.
 2. Outdoors: Provide as insulation coating Childers Encacel X.
 3. Underground: Provide Childers CP-22/24 for fittings and areas. Pittwrap cannot be used.
- C. Sealant. Provide Childers CP-76 vapor barrier sealant.
- D. Lagging Adhesive. Provide Childers CP-50.
- E. Other products of equal quality will be acceptable only upon approval.

2.7 ALUMINUM JACKETING

- A. Finish insulated piping outdoors with a smooth prefabricated Z-lock aluminum jacket 0.016" thick with factory applied 1 mil polyethylene/40 lb and Fab strap. Kraft moisture barrier. Childers Lock-On or approved equal.
- B. Valves, Fittings and Flanges. For finishing valves, fittings, flanges and similar installations, provide formed aluminum covers, 0.024" thick.
- C. Straps and Seals. Provide $\frac{1}{2}$ " x 0.020 stainless steel strapping and seals for jackets and covers according to manufacturer's recommendations.

2.8 GLASS FIBER BLANKET INSULATION

- A. Minimum density of 1.0 PCF, 2" thick, installed R value to be 6.0 or better at 75°F mean, facing of 0.35 mil foil reinforced with glass yarn mesh and laminated to 40 lbs fire resistant kraft.

PART 3 - EXECUTION

3.1 INTERIOR PIPING

- A. Cover all piping with glass fiber, heavy density, dual temperature pipe insulation with a vapor barrier jacket. Apply insulation to clean, dry pipes. Longitudinal seams shall be joined firmly together and sealed with self-sealing lap joints. Butt insulation joints firmly together and seal with a 3" wide ASJ butt strip seal. Longitudinal seams and butt strip laps shall be coated and sealed with CP-35 vapor barrier coating for chilled water piping applications.
- B. Install hanger with protective shield, on the outside of all insulation.
- C. Where domestic water pipes (1/2" & 3/4" pipe sizes) are installed on trapeze type hangers, provide galvanized sheet metal protection shields at these locations. Place insulation jacket directly on hanger. Incompressible, load bearing insulation segments are not required.
- D. Pipe Saddles: Formed galvanized sheets at each support point for insulated pipe, shaped to fit pipe, and covering bottom half of pipe. Length at saddle shall be not less than twice the insulation outside diameter. Provide 18-gauge through 4" pipe and 16-gauge for 5" pipe and above.
- E. Seal ends of pipe for drinking chilled water insulation with vapor barrier mastic at valves, flanges, fittings and every 21' on straight runs of piping. Mastic should extend on top of ASJ jacket, across the glass, down onto the pipe making a complete seal.
- F. Apply a smooth flood coat of white lagging Foster 8142W over all exposed insulation.
- G. Piping to be insulated as specified above:
 - 1. Domestic hot water and cold water (cold water piping is to be insulated in outside walls to 5' inside building, and in any location subject to freezing). Maintain insulation for domestic hot and cold water in Mechanical Rooms and Central Plant.
 - 2. Make-up water
 - 3. Horizontal sanitary drain piping that receives condensate
 - 4. Exposed to view storm drainage system including roof and overflow drain bodies, vertical piping from drain body to elbow, all horizontal rain leaders, and first elbow turning down

3.2 PIPING OUTDOORS ABOVE GRADE

- A. Insulate all water piping exterior of building above grade with rigid foam insulation and aluminum jacketing.
- B. Adhere the vapor barrier jacket longitudinal seam with vapor barrier adhesive.
- C. Cover all valves, fittings and flanges with factory made molded or field fabricated segments of pipe insulation of a thickness and material equal to the adjoining insulation. Adhere segments together with no voids, using CP-82 adhesive. Secure fitting insulation covers and segments in place with 1/2" wide glass filament tape.

- D. Apply a tack coat of fitting mastic over the insulation and tape.
- E. Neatly embed with 10 x 10 fiberglass cloth into the tack coat.
- F. Apply mastic over the fiberglass cloth to a thickness where the fabric is not visible after completion.
- G. Seal ends of pipe insulation with vapor barrier mastic at valves, flanges, fittings and every 21' on straight runs of piping. Mastic should extend on top of ASJ jacket, across the foam, down onto the pipe, making a complete seal.
- H. Finish with aluminum jacketing as specified.

3.3 FLANGE, VALVE AND FITTING INSULATION

- A. Cover valves and flanges with fabricated segments, fittings with two-piece factory molded fittings, and both of matching pipe insulation type and thickness equal to that of the adjoining pipe. Fittings and fabricated segments shall be securely held in place.
 - 1. Apply a tack coat of insulating mastic to the insulated fitting to produce a smooth surface.
 - 2. After mastic is dry, apply a second coat of vapor barrier mastic. Neatly embed with 10 x 10 fiberglass cloth into the tack coat.
 - 3. Overlap mastic and fiberglass cloth by 2" on adjoining sections of pipe insulation.
 - 4. Apply a second coat of mastic over the fiberglass cloth to present a smooth surface.
 - 5. Apply mastic to a wet film thickness of 3/64".
 - 6. Fabric shall not be visible after completion.
 - 7. Vapor seal flanges, valves and fittings with Childers CP-35.
- B. PVC fitting covers are not acceptable.

3.4 ALUMINUM JACKETING (Insulated Piping Outdoors Above Grade)

- A. Apply smooth aluminum jacket on piping, valves, fittings and flange covers according to manufacturer's recommendations, using stainless steel strapping and seals, to provide weather tight covering and to shed water.
- B. Aluminum jacketing is not considered as contributing to the vapor barrier or the insulation jacket. The vapor barrier must be sufficient in itself for this function. Lap each adjoining jacket section a minimum of 3" to make a weather tight seal.
- C. Install straps on 9" centers and at each circumferential lap joint.
- D. Cover and seal all exposed surfaces.
- E. The use of screws and rivets is not approved.
- F. Provide isolation (30# felt) between the aluminum jacket and the sheetmetal protection shield at each pipe support point.

3.5 CONCEALED STORM DRAIN PIPING

- A. Provide flexible glass fiber insulation with factory-applied, reinforced UL labeled Foil-Skrim-Kraft (FSK) facing. Install insulation of clean, dry piping.
- B. Insulation shall be wrapped tightly on the piping with all circumferential joints and longitudinal joints overlapped a minimum of 2" with facing to the outside to obtain specified R-value using

a maximum of 25% compression.

- C. Provide vapor retarder at penetrations, joints, seams and damage to the facing with staples and FSK foil tape. The facing shall be taped with a minimum 3" wide strip of reinforced foil tape. Pressure-sensitive tape shall be a minimum 3" (76mm) wide and shall be applied with moving pressure using an appropriate sealing tool. Staples shall be outward cinch and placed 6" (152mm) on center.
- D. Mechanical / Electrical rooms and above ceilings are considered concealed spaces.

3.6 MISCELLANEOUS

- A. Install materials after piping has been tested and approved.
- B. Apply insulation on clean, dry surfaces only.
- C. Apply weather protective finish on elastomeric insulation installed in non-conditioned spaces. Provide a minimum of three coats.

3.7 INSULATION THICKNESS

| <u>INSULATED UNIT</u> | <u>THICKNESS</u> <u>(Inches)</u> |
|---|-------------------------------------|
| Exposed Roof Drain Bodies and Horizontal Roof Drain Leaders | 1 |
| Exposed Roof Overflow Drain Bodies and Horizontal Drain Leaders | 1 |
| Domestic Cold Water/Make-Up Water Piping/Drinking Chilled Water | 1 |
| Horizontal Sanitary Drain Piping Which Receives Condensate | 1 |
| Domestic Hot Water Piping, 1-1/2" Pipe and Smaller | 1 |
| Domestic Hot Water Piping, 2" Pipe and Larger | 1-1/2 |

END OF SECTION

SECTION 22 11 16 - DOMESTIC WATER PIPING AND APPURTENANCES

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish and install domestic hot and cold water piping.

1.2 RELATED WORK

- A. Division 22 Plumbing
 - 1. Valves, Strainers and Vents
 - 2. Pipe and Pipe Fittings - General
 - 3. Plumbing Piping Insulation
 - 4. Plumbing Fixtures and Fixture Carriers

PART 2 - PRODUCTS

2.1 PIPING AND FITTINGS

- A. Below Slab on Grade Piping for Water Entries:
 - 1. 1-1/2-inch and smaller, provide ASTM B88 Type K (heavy wall) annealed tempered (soft) seamless copper water tube. No joints below slab entries.
 - 2. 2-inch and larger, provide Watts (Ames) IBR and IBR 2 304 stainless steel one piece in-building riser.
- B. Below Grade Piping Outside Building (beyond 5'-0" of building): Provide PVC water main pipe 4 inch through 12 inch in diameter in conformance with AWWA C900. When using 3" or smaller provide Schedule 80 PVC ASTM D1785 with ASTM D-2466 socket type fittings. Provide fittings in conformance with ASTM 2466. Furnish pipe with a minimum pressure rating of 150 lbs. per square inch. Provide PVC pipe as manufactured by Johns-Manville, CertainTeed, Clow or approved equal.
- C. Below Slab on Grade Piping. Furnish ASTM B 88 and ANSI/NSF Standard 61 annealed tempered (soft), Type K copper water tube. Run continuous with no joints under the floor slab. Provide copper pipe corrosion protection as specified in this Section.
- D. Above Slab Piping. Provide seamless ASTM B 88 and ANSI/NSF Standard 61 drawn tempered (hard) Type L copper water tube with wrought copper or bronze fittings with solder-joints, ANSI B16.22. Solder material shall be 95-5 (lead free) (Tin-Antimony-Grade 95TA) ASTM B 32.
- E. Unions. Provide 150 lb. standard unions with ground joint and bronze seat. Flange joints larger than 2 inches. Provide dielectric isolating unions at junctions or connection between metallic piping of dissimilar metal. Provide pipe threads with standard taper pipe threads ANSI B2.1.
- F. Alternate Method of Joining Copper Pipe and Tubing: Press Fittings: Copper press fitting shall conform to the material and sizing requirements of ASME B16.51. O-rings for copper press fittings shall be EPDM. VIEGA. The system intended for use shall be approved by submittal. Systems from various manufacturers may vary in technology. The field personnel shall carry training credentials from the approved manufacturer for the project. Mixing of fittings from different manufacturers is strictly prohibited.

2.2 WATER HAMMER ARRESTORS

- A. Provide piston type hydraulic engineered/manufactured water hammer arrestors in cold and hot water supply lines in chases or walls to each fixture branch or battery of fixtures serving quick closing valves of electrical, pneumatic, spring loaded type, or quick hand closure valves on fixture trim. Provide water hammer arrestors at the end of the branch line between the last two fixtures served. Provide Precision Plumbing Products, Inc., or equal. Size units according to water hammer arrestor's Standard PDI WH-201; refer to schedule on drawings.
- B. Install all water hammer arrestors so as to attain 100% effectiveness according to Plumbing and Drainage Institute PDI-WH201 Table 5, 6 and 6-A for water hammer arrestors.
- C. All water hammer arrestors shall be installed in a vertical position.
- D. All water hammer arrestors shall be accessible and shall have access panels where required. Arrestors located above ceilings in fixture drops will not be acceptable. Refer to sizing and placement data as indicated in PDI Standard PDI-WH-201.

PART 3 - EXECUTION

3.1 DRAINAGE

- A. Install water piping systems with uniform horizontal grade of 1/8 inch per 10 foot, minimum, to low points to provide complete system drainage. Where constant pitch cannot be maintained for long runs, establish intermediate low points and rise to new level. Grade branches to drain to mains or risers. Unless otherwise indicated, terminate low points of risers with drain valve piped to nearest hub or floor drain.

3.2 STERILIZATION

- A. Prior to starting work, verify system is complete, flushed and clean.
- B. Inject chorine disinfectant in liquid, powder, tablet or gas form throughout the system to obtain 50 to 80 Mg/L residual.
- C. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 20% of the outlets.
- D. Retain disinfectant in system for 8 hours (minimum), 24 hours (maximum). During the disinfection process, operate all valves and accessories.
- E. If final disinfectant residual tests less than 25 Mg/L, repeat treatment.
- F. Flush disinfectant from system until chemical and bacteriological tests prove water quality equal to that of the service main.
- G. Take samples no sooner than 24 hours after flushing from at least 10% of the outlets and from the water entry.
 - 1. Obtain a minimum of one water sample flushing from at least 10% of the outlets and from the water entry.
 - 2. Take samples from faucets located at highest point in the building, and farthest point from the main water supply.
- H. After final flushing, remove aerators, clean and replace.
- I. Chemical and bacteriological tests shall be conducted by a state certified laboratory.

- J. The firm performing the disinfection shall have chemical laboratory experience.
- K. Provide a laboratory report to indicate the following information.
 - 1. Name and address of the approved laboratory testing the samples.
 - 2. Name and location of the project and date the samples were obtained.
 - 3. Mg/L chlorine during retention.
 - 4. Mg/L chlorine after flushing.
 - 5. The coliform organism count. (An acceptable test shall show absence of coliform organisms.)
- L. If analysis does not satisfy the specified minimum requirements, repeat the disinfection procedure.
- M. Submit for approval to the Architect/Engineer a copy of the laboratory report and the certification of performance. An approved copy of each document shall be inserted in the Owner's manual.

3.3 UNDERGROUND WATER PIPING SYSTEM PROCEDURES

- A. Lay sewer and water lines in separate trenches, separated by 10 foot of undisturbed or compacted soil.

3.4 TESTING

- A. Test under a cold water hydrostatic pressure of 1-1/2 times operating pressure (150 psig minimum) and carefully check for leaks. Repair leaks and retest system until proven watertight.
- B. Test the domestic water piping system at 150psig hydrostatic pressure, maintained for 6 hours.
- C. Use only potable water for the test.
- D. Perform the test before fixtures, faucets, trim or final connections are made to equipment.
- E. If the system is tested in sections, the entire domestic water piping system shall be submitted to a final test, employing the specified procedure.
- F. Do not insulate or conceal piping systems until tests are satisfactorily complete.
- G. If any leaks or other defects are observed, suspend the test and correct the condition at once. Repeat testing until leaks are eliminated and the full test period is achieved.
- H. The satisfactory completion of testing does not relieve the Contractor of responsibility for ultimate proper and satisfactory operation of piping systems and their accessories.

3.5 COPPER PIPE CORROSION PROTECTION

- A. Corrosion protect copper tube piping systems:
 - 1. In the building slab.
 - 2. Beneath the building slab.
 - 3. Buried.
 - 4. Route plasti-sleeve 0.006 thick material entire length of below slab on grade copper tubing.

- B. Cover copper tubing piping system with:
 - 1. "Tapecoat" TC Primer.
 - 2. "Tapecoat" CT cold applied coating tape.
- C. Install coating system as specified by the manufacturer.
- D. Extend the corrosion protection 2 inches above concrete slab on grade.

3.6 TEST OF PIPE CORROSION PROTECTION SYSTEM

- A. Test the pipe corrosion protection coating with an approved high voltage tester adjusted to provide sufficient voltage to produce a spark through a pinhole in the coating (at least 15 kv AC).
- B. Make repairs to small holes in accordance with the manufacturer's instructions.
- C. Retest the repairs using procedures listed above.
- D. Furnish certificate of compliance with field testing in Owner's manual.

END OF SECTION

**SECTION 22 11 19 - PIPING AND PIPING APPURTENANCES FOR
COLD WATER MAKEUP**

PART 1 - WORK INCLUDED

1.1 SCOPE

- A. Furnish and install piping and piping appurtenances for cold water makeup piping.

1.2 RELATED WORK

- A. Division 22 Plumbing
 1. Valves, Strainers and Vents
 2. Plumbing Pipe and Pipe Fittings
 3. Plumbing Piping Insulation

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

- A. Provide seamless, hard-drawn, Type L, copper water tube conforming to ASTM B88, and wrought copper fittings.

2.2 BACKFLOW PREVENTER

- A. Watts Series #909 reduced pressure principal backflow preventer, 3/4" through 2".
- B. Apollo RPLF 4A Series reduced pressure backflow preventer 2-1/2" and larger in stainless steel body.
- C. Factory assembled components as follows:
 1. Isolating, shutoff, full port ball valves.
 2. Incoming bronze strainer.
 3. Test cocks.
 4. Fixed air gap assembly.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install according to manufacturer's instructions.

3.2 BACKFLOW PREVENTERS

- A. Provide backflow preventers at the following locations.
 1. HVAC Systems cold water make-up including chilled water, hot water and condenser water.
 2. Pumping systems including water utility service and water softening equipment.
 3. Where required by Code.
- B. Installation according to manufacturer's recommendations.
 1. Connect drain with fixed air gap assembly.
 - a. Pipe full size discharge from relief valve of RPZ to nearest floor drain or floor sink of proper size. Reference manufacturer's suggested sizing of drains.

2. Provide pipe unions on inlet, outlet and discharge connection of the assembly for complete removal.
 3. Provide isolation valve upstream of backflow assembly to allow complete removal of listed assembly.
 4. Install backflow preventer assembly horizontally in an accessible location for testing and maintenance at a height not to exceed 60" above finished floor and no lower than 12" from finished floor to air gap outlet.
- C. Provide certified testing of all backflow preventers.
1. Include certificates in O&M Manuals.

END OF SECTION

SECTION 22 11 23 - DOMESTIC WATER PUMPS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. General characteristics for pumps specified in Division 22 - Plumbing.

1.2 RELATED WORK

Requirements for pumps are specified in other sections of Division 22 - Plumbing, including the following:

- A. Division 22 Plumbing - Electrical Provisions of Plumbing Work.

1.3 PUMP SELECTION

- A. Select pumps conservatively for scheduled conditions. Furnish pumps that have reasonably high efficiencies, with peak efficiency at or near rated conditions. Select pumps that will operate stably at 15' suction lift despite substantial reduction in head or substantial increase in delivery.
- B. If the pumps proposed are not considered suitable, submit manufacturer's data on other pumps, for review.
- C. Scheduled design flow, design head, pump efficiency, and motor horsepower are the minimum acceptable.
- D. The pump curve shall rise continuously from maximum flow to cut-off.
- E. Shut-off head approximately 10 percent greater than design head, unless otherwise indicated in pump schedules.
- F. Pump brake horsepower shall not exceed the motor horsepower rating over the entire operating range from shut-off to run-out.
- G. Select the pump for operation at or near peak efficiency.
- H. Cavitation-free at all points on the curve.
- I. Impeller diameter shall not exceed 90 percent of the maximum published diameter.

1.4 PUMP SIZE AND TYPE

- A. Provide motor-driven pumps of the type and speed scheduled. Select pumps that are not overloaded throughout the entire range of pump operation. Provide pump connection sizes as indicated.
- B. Submit copies of manufacturer's performance curves, as shop drawings on each pump. Clearly mark the curves for each pump to indicate the diameter of the impeller and the selection point.

1.5 CERTIFIED DATA

- A. Submit factory certified pump curves showing pump performance characteristics with pump and system operating points plotted. Curves shall include as a minimum, flow

(gallons per minute), head (feet of water), all available impeller diameters (inches), efficiency (percent), net positive suction head required (feet of water), brake horsepower, pump size and pump model. Show pump curves with system curve plotted.

PART 2 - PRODUCTS

2.1 DOMESTIC HOT WATER CIRCULATING PUMPS (Variable Speed) FRACTIONAL HORSEPOWER

- A. Pump Construction:
 - 1. Variable speed with automated ability to adjust and maintain optimum operating conditions Stainless steel housing
 - 2. Check Valve
 - 3. Flange or union connections
 - 4. Built in timer
 - 5. Built in temperature sensor
 - 6. Build in differential pressure sensor
 - 7. Programmable
- B. Acceptable manufacturers:
 - 1. Grundfos
 - 2. Armstrong
 - 3. Wilo

2.2 FLOW INDICATOR

- A. Flow Indicator
 - 1. Bronze Construction
 - 2. Rotating wheel
 - 3. Line Size
 - 4. Double Window
 - 5. Ernst Flow Industries Model EFI E-57-3

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install the pumps in accordance with Manufacturer's "Installation, Start-up and Service Instructions".
 - 1. Provide access space around pumps for service.
 - 2. Lubricate pumps prior to start-up.
 - 3. Install hot water circulator horizontally, properly supported to wall, in an accessible location for testing and maintenance at a height not to exceed 60" above finished floor. Install line size Ernst bronze rotating wheel, flow indicator with double window, downstream of circulator.
- B. Provide a line size isolation valve and strainer on the pump suction and a line size silent check valve and balancing valve on the pump discharge.
- C. Support piping adjacent to the pump such that no weight is carried on the pump casing. Decrease from pipe size with eccentric reducer on suction side and concentric increaser on discharge side.
- D. Ensure pumps:
 - 1. Operate at specified system fluid temperatures without vapor binding and cavitation.

2. Are non-overloading in parallel and individual operation.
 3. Operate within 25 percent of midpoint of published maximum efficiency curve.
- E. Refer to pump detail on the Contract Drawings for piping accessories to be provided.

3.2 ALIGNMENT FOR BASE MOUNTED PUMPS

- A. Set the pump on a concrete inertia base or concrete housekeeping pad as specified. Anchor, level and grout.
- B. Align the pump and driver in accordance with Hydraulic Institute Standards for centrifugal, rotary and reciprocating pumps.
- C. Realign the pump and driver after initial leveling of pump base before placing the grout and again after the grout has set and the foundation bolts are tightened. Recheck the alignment after the piping has been connected.

3.3 MANUFACTURER START-UP SERVICE ALIGNMENT

- A. After installation, the pumps and motors are to be aligned by the manufacturer or their representative utilizing a dial indicator. After completion, a formal report must be submitted by the Manufacturer to the Engineer prior to final acceptance. This report must include pump serial number, location, beginning and final alignment at a minimum.
 1. Technicians, as required, shall be trained and experienced in the work they perform (Contractor start-up / alignment is unacceptable).
- B. Before starting pumps, but after connecting piping:
 1. Align shafts and coupling with a precision dial indicator alignment instrument to the minimum tolerances .004 (TIR) per inch of coupling radius or as recommended by the manufacturer, whichever is the greater.
 2. Tabulate the actual pump alignment reading with manufacturer's minimum tolerances.
 3. Submit readings for approval.
 4. Include the approved readings in the Owner's Maintenance Manual.

3.4 FINAL PUMP FLOW CALIBRATION

- A. Based on the results of the final phases of the test and balance sequences, if the flow of the unthrottled pump is more than 10% above the scheduled values:
 1. Request detailed instructions from the pump manufacturer for the correct impeller diameter.
 2. Trim the impeller to the diameter recommended by the manufacturer, employing precision machinery.
- B. Enter the information on the final configuration of the pump in the Owner's Manual.
 1. Modify the pump nameplate to reflect the correct head and flow data and the impeller diameter.

3.5 SPARE PARTS

- A. Provide the following spare parts and material to the Owner for his use after the warranty period.
 1. A mechanical seal for each pump
 2. A set of bearings for each pump

END OF SECTION

**SECTION 22 13 16 - SOIL, WASTE AND SANITARY DRAIN PIPING, VENT PIPING
AND APPURTENANCES**

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish and install piping in buildings and underground laterals to 5 foot outside of building.

1.2 RELATED WORK

- A. Site Work:
1. Sanitary Sewers
 2. Excavation, Trenching and Backfilling for Utilities
- B. Division 22 Plumbing:
1. Pipe and Pipe Fittings
 2. Plumbing Fixtures and Fixture Carriers
 3. Drains, Cleanouts and Hydrants
 4. Earthwork

1.3 REFERENCES

- A. CISPI - Cast Iron Soil Pipe Institute
- B. ASTM - American Society for Testing and Materials

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. All No-Hub clamps must have 4 bands minimum. Sizes 5" through 10" shall have six bands minimum.
1. No-Hub Clamps – Sanitary Waste:
 - a. Husky SD 4000
 2. No-Hub Clamps - Vents
 - a. Husky SD – 2000
 - b. Mission Rubber Co., LLC Heavy Weight Couplings
- B. Provide Anaco-Husky shielded couplings Series 4200 with one piece neoprene gasket for all cast iron pipe transitions to Schedule 40 DWV pipe penetrations through slabs. Sizes 1-1/2" through 8" Series 4200.
- C. Cast Iron Soil Pipe and Fittings:
1. AB&I
 2. Charlotte Pipe and Foundry Co.
 3. Tyler Pipe / Soil Division

2.2 DRAIN PIPE AND FITTINGS

- A. Above Slab Pipe:
1. No-hub cast iron soil pipe and fittings shall conform to CISPI 301 and ASTM A888.
 2. Pipe shall conform to ASTM A74.

3. No-hub couplings shall meet or exceed the latest specification standard CISPI 310 or ASTM C-1540 and conform to FM 1640. CISPI 310 Couplings shall be listed by NSF International.
 4. Rubber Gaskets for cast iron soil pipe and fittings shall conform to ASTM C564
 5. All Cast Iron Soil Pipe and Fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute
- B. Below Slab on Grade Piping:
1. Schedule 40 PVC plastic pipe and DWV fittings. 4" SDR pipe is not allowed.
 2. Solvent welded DWV joints shall conform to IAPMO Installation Standard IS-9.
 3. Pipe and fittings shall conform to ASTM D 1784, ASTM D 1785, ASTM D 2665, ASTM D 3311 and NPS Standard 14 & 61.

2.3 VENT PIPE AND FITTINGS

- A. Above Slab Pipe:
1. No-hub cast iron soil pipe and fittings shall conform to CISPI 301 and ASTM A888.
 2. Pipe shall conform to ASTM A74.
 3. No-hub couplings shall conform to CISPI 310 and shall be listed by NSF International
 4. Rubber gaskets for cast iron soil pipe and fittings shall conform to ASTM C564
- B. Below Slab on Grade Piping:
1. Provide Schedule 40 PVC with DWV fittings with solvent welded joints. Pipe and fittings shall conform to ASTM D1784-82.
- C. Above Slab Pipe.
1. Drainage-waste-vent copper pipe and fittings for waste stub-outs for all fixture locations and equipment discharge.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. All above and below slab soil, waste, sanitary drain and vent piping installation methods shall be in accordance with Cast Iron Soil Pipe Institute Standards.
- B. Above ground installation in the horizontal position shall be supported at every hub (hub & spigot or hubless type). Hangers are to be placed within 18" of hub or coupling. For large diameter fittings, 5 inches and larger shall be braced to prevent horizontal movement. Every branch opening or change of direction, braces, blocks, rodding or other suitable method shall be used to prevent movement. Riser clamps to be used for each floor, not to exceed 15'-0".
- C. All above and below slab PVC sanitary waste and vent piping installation methods shall be in accordance with IAPMO Installation Standard 18-9 for Schedule 40 PVC-DWV, per manufacturer's recommendations and applicable standards.
- D. Tracer wires shall be installed on all underground PVC sanitary sewer lines installed outside the building slab.
- E. All PVC underground shall be installed in accordance with ASTM D2321.

3.2 GRADE

- A. Give horizontal pipe grade of $\frac{1}{4}$ -inch per foot where possible, but not less than $\frac{1}{8}$ inch per foot unless otherwise shown.

3.3 DRAIN PIPE AND FITTINGS

- A. Offsets and Fittings.
 - 1. Use reduction fittings to connect two pipes of different diameter.
 - 2. Change directions by appropriate use of 45-degree wyes, long-sweep quarter-bends, and sixth-, eighth-, and sixteenth-bends. Sanitary tees can be used on vertical stacks. Use long sweeps at the base of risers.
 - 3. Provide a separate trap at each fixture, unless a trap is built into the fixture. Provide a deep seal trap at each floor drain and hub drain. Place traps so that the discharge from any fixture will pass through only one trap before reaching a building drain.
 - 4. Do not use double combinations or cross fittings below slab.
 - 5. Refer to Sanitary Drainage Code section for acceptable fittings to be used for changes in direction of drainage flow. Double combo sanitary fittings or double wye and $\frac{1}{8}$ th bend fittings are not allowed for horizontal to horizontal piping systems per Code.
- B. Hub Drains. Install hub drains where indicated, with the top of the hub $\frac{1}{2}$ above the finished floor, unless otherwise indicated on the drawings.
- C. Cleanouts. Install cleanouts the same size as the soil waste lines in which the cleanouts are placed; however, no cleanout should be larger than 4 inches in diameter.
 - 1. Where cleanouts occur in pipe chases, bring the cleanouts through the walls and install covers. Where cleanouts occur in floor slabs, set flush. Reference drawing schedule.
 - 2. Provide cleanouts where soil lines change direction, every 75 foot on long runs, or as shown on the drawings, at the end of each horizontal waste line, and at the base of each riser (and at each increase in pipe size).
 - 3. Cleanouts shall occur at the end of each battery of water closets, urinals, lavatories, sinks, and single water closets. Cleanouts shall be installed so as to access the main sanitary or soil line. Extend and offset above flood rim of water closet.
 - 4. Double sanitary tees and double quarter bends do not allow for easy access to main lines, therefore these types of fittings are not allowed.
 - 5. Provide cleanout above all sanitary cross fittings and Figure 5 fittings in chase walls, etc.
 - 6. Do not provide gasket markers in carpeted areas. Do provide full cleanouts with top fully exposed.
 - 7. For large garbage disposers in kitchens, install a cleanout between the disposer and the P-trap and at the wall.
 - 8. Notify civil to have manholes at connections to main at each exit point.
- D. Floor Drains. Locate floor drains $\frac{1}{2}$ -inch below finish floor elevation unless otherwise shown.

3.4 VENT PIPING

- A. Make vent connections to vent stacks with inverted wye fittings. Extend full-size vents through the roof to at least 6 inches above the roof.
- B. Flash the roof penetration with 6 lb. lead flashing approximately 24 inches square. Flange the flashing to the lead sleeve. Extend the flashing up and around the vent pipe. Turn the flashing down inside the pipe at least 2 inches to make a watertight joint. Flashing shall

comply with the roofing manufacturer's requirements. Reference the Architectural Drawings for exact requirements.

- C. Locate vent piping through roof a minimum horizontal distance of not less than 20 feet from any air intake opening or supply fan.
- D. During demolition, abandoned plumbing vents are to be removed in their entirety. Do not cap the vent pipes below the roof deck and abandon in place. The hole in the roof is to be patched and made water tight.

3.5 TESTING

- A. Below Slab on Grade and All Floors in Multi-Story Buildings:
 - 1. Test pipe below slab on grade before backfilling and connecting to city sewers.
 - 2. Maintain not less than 10 foot of hydrostatic head for 1 hour without a leak.
 - 3. Before acceptance of the work the contractor must ensure the piping is in working order before and after the slab is poured. To ensure this the contractor must test completed systems in the presence of the Architect, Engineer and authorities having jurisdiction after installation is complete.
 - 4. Maintain the test on the system till after the slab is poured. Provide an accessible connection that may be reviewed by Architect, Engineer and authorities having jurisdiction prior to and after the slab is poured.
 - 5. Test drainage piping systems in accordance with governing codes and the requirements specified. Provide equipment and materials and make test connections required to execute tests.
 - 6. Test drainage and waste piping hydraulically by filling system to its highest point or, whichever is greater, at a static head of 10 feet. Leaks at any joint shall be sufficient cause for rejection.
 - 7. Air tests may be substituted for hydraulic tests by forcing air into the closed system at a uniform pressure sufficient to balance a column of 10 inch hg in height.
 - 8. Under any of the previously described tests, the water height shall remain constant, after stabilization, for not less than 15 minutes without any further addition of water.
- B. System Test. After the various sections of soil, waste and vent piping are installed, but before fixtures are connected, test the system by:
 - 1. Plugging outlets.
 - 2. Filling vertical sections of multiple story buildings of not less than three floors at a time with water. Provide wyes as required to facilitate plugging.
 - 3. Test for 6 hours without any drop in the water level.

3.6 RODDING SEWERS

- A. All sanitary soil and waste lines, both in the building and out, shall be rodded out and flushed out after completion of construction and prior to finish floor being installed. All work must be completed prior to substantial completion. All floor drains and cleanout locations must be included in this work.
- B. All sanitary soil and waste lines below building 3" and larger shall be internally videotaped at time of substantial completion and on existing piping prior to construction. All videotaping shall include on-screen date and time and include audio narration. All videotaping shall be provided by experienced individual in videotaping piping systems. CFISD must be notified 24 hours prior to start time of video inspection. An Owner's Representative, CFISD plumbing foreman, or his designee shall be present during video-taping. Three copies of the videotape shall be delivered to the Owner for future records.

- C. This work shall be done in the presence of the Owner's Representative, CFISD plumbing foreman, or his designee as part of the Contract, to ensure all lines are clear, and any obstruction that may be discovered shall be removed immediately. Rodding shall be accomplished by utilizing the proper rotary head to clear sewer. Pipe sizes 8 inches and larger shall be hydro-flushed.

3.7 SMOKE TESTING – LIQUID SMOKE SYSTEM

- A. Interior Plumbing Piping:
1. Contractor shall perform smoke testing for finding leaks in all interior of building sanitary sewer piping, acid waste and vent piping, and sanitary vent piping above and below building slab prior to cover up.
 2. Contractor must use a laboratory tested safe liquid smoke with a patented liquid smoke generating system. The liquid smoke must be contained in a pressure tank with inline filter and quick disconnect.
 3. Contractor shall provide a continuous smoke flow for testing the entire piping system in lieu of partial testing done by sections at a time. Partial testing will not be acceptable.
 4. Smoke generating system must generate up to 3 hours or more of continuous and constant smoke. Generating system must have a metering valve to precisely control smoke flow and density. Smoke generating system must have a 4" x 6" industrial flexible mining duct for connection to vent stack or cleanout or sit atop a manhole outside.
 5. Smoke generating system must be power full enough to push smoke through the smallest leaks.
 6. The liquid smoke must not leave any stains or odors.
 7. The liquid smoke shall not contain Zinc Chloride, a listed toxic compound in OSHA 1915,1000 – Air contaminants.
 8. Smoke generating system must have a means to atomize the liquid smoke and have an enclosed fan system capable of up to 700 cfm with adjustable inlet damper control to adjust cfm as necessary for the size of system.
 9. Provide Hurco "Power smoker "with Hurco "LiquiSmoke" system or approved equal. No smoke bombs allowed.
 10. All plumbing fixtures must be installed including floor drains with wetted trap seals.
 11. Smoke testing shall be performed after completion of any videotaping, rodding or flushing of the sanitary system. Test must be performed prior to ceiling installation in new construction projects. Smoke is usually injected into the building through the two-way cleanout in the main sewer line leaving the building or a plumbing roof vent or fixture. Plug piping as necessary as to force all smoke into building. Smoke can also be admitted through a manhole. Smoke will travel through the sanitary sewer and vent system and through the air spaces in the sewer lines and emanate from any leaks in the system. The smoke must reach the last roof vent in the system to indicate the entire system has been completely filled with smoke. The smoke must travel the full length of the piping system. Contractor must provide manpower as necessary to visually trace the flow of smoke through the wall cavities, annular floor/ceiling spaces, inject the smoke, observe the roof vents and to identify the integrity problems.
 12. Contractor shall provide a detailed list of findings and a drawing indicating the location, fixture type, type and size of pipe, and or description of type of problems found.
 13. Typical findings from indoor smoke testing may include:
 - a. Dry traps in floor drains
 - b. Improperly capped sewer lines or vents
 - c. Broken sewer lines or vents
 - d. Cross connected sewer vents and drains

- e. The drawing of air emanating from sewer vents into intakes of air exchange systems
 - f. Poorly glued pipe joints
 - g. Loose no-hub couplings
14. An Owner's Representative shall be present during smoke testing.

END OF SECTION

SECTION 22 14 13 - ROOF DRAINAGE PIPING AND APPURTENANCES

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish and install roof drains, drain pipes and accessories.

1.2 RELATED WORK

- A. Division 22 Plumbing
 1. Pipe and Pipe Fittings - General; for general piping requirements.
 2. Drains and Cleanouts.
 3. Plumbing Piping Insulation.
 4. Earthwork

1.3 REFERENCES

- A. CISPI – Cast Iron Soil Pipe Institute
- B. ASTM – American Society for Testing and Materials

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Cast Iron Soil Pipe and Fittings
 1. AB&I
 2. Charlotte Pipe and Foundry Co.
 3. Tyler Pipe / Soil Division

2.2 STORM PIPE AND FITTINGS

- A. Above Ground Pipe. Provide service weight cast iron Hub and Spigot soil pipe and fittings with compression type neoprene gaskets that conform to ASTM C-564. Pipe and fittings shall meet the requirements of ASTM A 74. All cast iron soil pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute.
- B. Below Slab on Grade: Provide Schedule 40 PVC plastic pipe and DWV fittings with solvent welded joints. Pipe and fittings shall conform to ASTM D 1784-82.
- C. Provide Anaco-Husky shielded couplings, Series 4200 with one-piece neoprene gasket for cast iron pipe transitions to Schedule 40 DWV pipe penetrations through slabs. Sizes 2" through 8" use Series 4200.
- D. All no-hub couplings connections to roof drains to piping must be located below the metal decking.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. All above and below slab storm piping installation methods shall be in accordance with the Cast Iron Soil Pipe Institute Standards.

- B. Above ground installation in the horizontal position shall be supported at every hub (hub & spigot or hubless type). Hangers to be placed within 18" of hub or coupling. For large diameter fittings, 5 inches and larger shall be braced to prevent horizontal movement. Every branch opening or change of direction, braces, blocks, rodding or other suitable method shall be used to prevent movement. Riser clamps to be used for each floor, not to exceed 15'-0".
- C. All above and below slab PVC storm piping installation methods shall be in accordance with IAPMO Installation Standard 18-9 for Schedule 40 PVC-DWV, per manufacturer's recommendations and applicable standards, and in accordance with ASTM D2321.

3.2 GRADE

- A. Give horizontal lines minimum grade of 1/8 inch per foot.

3.3 TESTING

- A. Below Slab on Grade and All Floors in Multi-Story Buildings:
 - 1. Test pipe below slab on grade before backfilling and connecting to city sewers.
 - 2. Maintain not less than 10 foot of hydrostatic head for 1 hour without a leak.
 - 3. Before acceptance of the work the contractor must ensure the piping is in working order before and after the slab is poured. To ensure this the contractor must test completed systems in the presence of the Architect, Engineer and authorities having jurisdiction after installation is complete.
 - 4. Maintain the test on the system till after the slab is poured. Provide an accessible connection that may be reviewed by Architect, Engineer and authorities having jurisdiction prior to and after the slab is poured.
 - 5. Test drainage piping systems in accordance with governing codes and the requirements specified. Provide equipment and materials and make test connections required to execute tests.
 - 6. Test drainage and waste piping hydraulically by filling system to its highest point or, whichever is greater, at a static head of 10 feet. Leaks at any joint shall be sufficient cause for rejection.
 - 7. Air tests may be substituted for hydraulic tests by forcing air into the closed system at a uniform pressure sufficient to balance a column of 10 inch hg in height.
 - 8. Under any of the previously described tests, the water height shall remain constant, after stabilization, for not less than 15 minutes without any further addition of water.
- B. System Test. After the various sections of soil, waste and vent piping are installed, but before fixtures are connected, test the system by:
 - 1. Plugging outlets.
 - 2. Filling vertical sections of multiple story buildings of not less than three floors at a time with water. Provide wyes as required to facilitate plugging.
 - 3. Test for 6 hours without any drop in the water level.

END OF SECTION

SECTION 22 20 00 - PLUMBING PIPE AND PIPE FITTINGS - GENERAL

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish and install pipe and pipe fittings for piping systems specified in Division 22 - Plumbing.

1.2 RELATED WORK

- A. Division 22 Plumbing
 1. Earthwork
 2. Valves, Strainers and Vents
 3. Insulation
 4. Other Piping Sections

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

- A. The particular type of pipe and fittings for each system is specified in the individual sections.

2.2 JOINTS

- A. Make screwed joints using machine cut USASI taper pipe threads. Apply a suitable joint compound to the male threads only. Ream the pipe to full inside diameter after cutting. All-thread nipples are not permitted.
- B. Dissimilar Metals. Make joints between copper and steel pipe and equipment using insulating unions or couplings such as Crane Company #1259; EPCO as manufactured by EPCO Sales, Inc.; or an approved equal.
- C. Solder joints.
 1. Prior to making joints, cut pipe square and ream to full inside diameter. Clean exterior of pipe and socket. Apply a thin coat of suitable fluxing compound to both pipe and socket, and fit parts together immediately.
 2. Heat assembled joint only as required to cause the solder to flow. Run the joint full, slightly beaded on the outside, and wipe to remove excess solder.
 3. Use silver brazing alloy or Sil-Fos on underground water entry piping. Use lead free solder on all other copper piping.
- D. Make welded joints as recommended by the standards of the American Welding Society. Ensure complete penetration of deposited metal with base metal. Provide filler metal suitable for use with base metal. Keep inside of fittings free from globules of weld metal. The use of mitered joints is not approved.
- E. Flanged.
 1. Prior to installation of bolts, center and align flanged joints to prevent mechanical pre-stressing of flanges, pipe or equipment. Align bolt holes to straddle the vertical, horizontal or north-south centerline. Do not exceed 3/64" per foot inclination of the flange face from true alignment.
 2. Use flat-face companion flanges only with flat-faced fittings, valves or equipment. Otherwise, use raised-face flanges.

3. Install gaskets suitable for the intended service and factory cut to proper dimensions. Secure with manufacturers recommended gasket cement.
 4. Use ANSI nuts and bolts, galvanized or black to match flange material. Use ANSI 316 stainless steel nuts and bolts underground. Tighten bolts progressively to prevent unbalanced stress. Draw bolts tight to ensure proper seating of gaskets.
 5. Use carbon steel flanges conforming to ANSI B16.5 with pipe materials conforming to ASTM A 105 Grade II or ASTM A 108, Grade II, ASTM A 53, Grade B. Use slip-on type flanges on pipe only. Use welding neck type flanges on all fittings. Weld slip-on flanges inside and outside.
 6. Keep flange covers on equipment while fabricating piping. Remove when ready to install in system.
- F. No Hub. Hubless joints shall be made with wide body, neoprene sealing sleeve with stainless steel sleeve, coupling joints conforming to ASTM C 1277.
1. 4" pipe size and smaller coupling housing minimum of 3" width; 24 gauge Series 300 stainless steel with hi-torque clamps; neoprene coupling gasket.
 2. 6" through 10" pipe size coupling housing minimum of 4" width.
 3. Tighten clamps to within manufacturer's tolerances using preset torque wrench.
- I. Compression Gasket System. Bell and spigot cast iron pipe 4" and smaller, use flax-base lubricant, Tyler Ty-Seal Lubricant or Charlotte Regular Lubricant. 6" and larger use a neoprene base lubricant, Charlotte Adhesive Lubricant.
- J. Ring-Tite Joints: Furnish joints for installation according to manufacturer's recommendations. Provide adequate concrete thrust blocks at changes in direction, as recommended by manufacturer. JM Eagle pressure rated PVC water pipe. ASTM D2241 pressure rating, ASTM D3219 joints, gaskets ASTM F477.
- M. Press fittings for copper pipe 1/2" to 4": Copper press fittings shall conform to the material and sizing requirements of ASTM B16.18 or ASME B16.22. O-rings for copper press fittings shall be EPDM. Pro-Press System manufactured by VIEGA. The system intended for use shall be approved by submittal. Systems from various manufacturers may vary in technology. The field personnel shall carry training credentials from the approved manufacturer for the project. Mixing of fittings from different manufacturers is strictly prohibited.

2.3 UNIONS

- A. Use 150 lb. standard (300 lb. WOG) malleable iron, ground joint unions with bronze seat. Provide flanged joints on piping 2-1/2" and larger.
1. Where pipe materials of different types join, use a dielectric union. Union shall be threaded, solder or as required for its intended use.

2.4 BRANCH CONNECTIONS

- A. Pipe 2" and Smaller. For threaded piping, use straight size reducing tee. When branch is smaller than header, a nipple and reducing coupling or swagged nipple may be used.
- B. 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.

2.5 GASKETS

- A. High Temperature Piping. Provide 1/16" thick ring gaskets of aramid reinforced SBR such

as Garlock #3200 or 3400 or equal by Advanced Products and Systems.

- B. Other Piping. Provide ring rubber gaskets, Garlock #7992 or equal by Advanced Products and Systems. Use 1/8" thick cloth reinforced neoprene gaskets. For smaller than 6", use 1/16" thick gasket.

2.6 FLOORS AND CEILING PLATES

- A. 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.

2.7 DOMESTIC MANUFACTURE

- A. All piping material, pipe and pipe fittings shall be manufactured in the United States of America unless specifically named in these specifications.

PART 3 - EXECUTION

3.1 PIPE FABRICATION AND INSTALLATION

- A. Make piping layout and installation in the most advantageous manner possible with respect to headroom, valve access, opening and equipment clearance, and clearance for other work. Give particular attention to piping in the vicinity of equipment. Preserve the required minimum access clearances to various equipment parts, as recommended by the equipment manufacturer, for maintenance.
- B. Cut all pipes to measurement determined at the site. After cutting pipe, remove burrs by reaming. Bevel plain ends of ferrous pipe.
- C. Install piping neatly, free from unnecessary traps and pockets. Work into place without springing or forcing. Use fittings to make changes in direction. Field bending and mitering is prohibited. Make connections to equipment using flanged joints, unions or couplings. Make reducing connections with reducing fittings only.
- D. Install piping without tapping out of the bottom of pipe.
- E. Press Connections: Copper press fittings ½" through 4" shall be applied in accordance with the manufacturer's installation instructions. The tubing/pipe shall be fully inserted into the fitting and the tubing/pipe marked at the shoulder of the fitting. The fitting alignment shall be checked against the mark on the tubing/pipe to assure the tubing/pipe is fully engaged (inserted) in the fitting. The joints shall be pressed using the tool approved by the manufacturer. If soldering (thread adapters, etc.) near press fittings, take precautions to not damage the O-ring fittings. Maintain three pipe diameters or use a cooling agent. Viega-"Pro-Press".

3.2 WELD

- A. Weld and fabricate piping in accordance with ANSI Standard B31.1, latest edition, Code for Pressure Piping.
- B. Align piping and equipment so that no part is offset more than 1/16". Set fittings and joints square and true, and preserve alignment during welding operation. Use of alignment rods inside pipe is prohibited.

- C. Do not permit any weld to project within the pipe so as to restrict flows. Tack welds, if used, must be of the same material and made by the same procedure as the completed weld. Otherwise, remove tack welds during welding operation.
- D. Do not split, bend, flatten or otherwise damage piping before, during or after installation.
- E. Remove dirt, scale and other foreign matter from inside piping before tying into existing piping sections, fittings, valves or equipment.
- F. Bevel ends of ferrous pipe.

3.3 OFFSETS AND FITTINGS

- A. Due to the small scale of drawings, the indication of offsets and fittings is not possible. Investigate the structural and finish conditions affecting the work and take steps required to meet these conditions.
- B. Install pipe close to walls, ceilings and columns so pipe will occupy minimum space. Provide proper spacing for insulation coverings, removal of pipe, special clearances, and offsets and fittings.

3.4 SECURING AND SUPPORTING

- A. Support piping to maintain line and grade, with provision for expansion and contraction. Use approved clevis-type or trapeze-type hangers connected to structural members of the building. Single pipe runs to be supported by approved clevis type hangers. Multiple pipe runs to be supported by approved trapeze type hangers. Do not support piping from other piping or structural joist bridging.
- B. Provide supports both sides of elbows for pipe 6" and larger.
- C. Support vertical risers with steel strap pipe clamps of approved design and size, supported at each floor. Support piping assemblies in chases so they are rigid and self-supported before the chase is closed. Provide structural support for piping penetrating chase walls to fixtures. On cold water pipe, supports shall be outside the insulation.
- D. Where insulation occurs, design hangers to protect insulation from damage. Pipe saddles and insulation shields, where required, are specified in the appropriate insulation section and are sized in accordance with the schedule on the drawings.
- E. Install trapeze hangers, properly sized, to support the intended load without distortion.
- F. Use electro-galvanized or zinc plated threaded rods, nuts, washers and hangers.
- G. At outdoor locations, all supports, brackets and structural members shall be hot-dipped galvanized.
- H. Support spacing: As recommended by the project structural engineer and support manufacturer, but not more than listed below. Not to exceed spacing requirements of smallest pipe.

| Pipe Size | Copper & Steel Max. Support Spacing, Feet | Cast Iron Max. Support Spacing, Ft. | Minimum Rod Diameter, Inches |
|-----------------|---|-------------------------------------|------------------------------|
| 1" & smaller | 6 | | 3/8 |
| 1-1/4" & 1-1/2" | 8 | 5 | 3/8 |
| 2" | 10 | 5 | 3/8 |
| 3" | 10 | 5 | 1/2 |
| 4" & 5" | 10 | 5 | 5/8 |
| 6" and above | 10 | 5 | 3/4 |

3.5 PIPE SUPPORTS

- A. Provide P1001 or P 5000 Unistrut metal framing members and appurtenances for pipe support. Hot-dip galvanize members and appurtenances when located outside. Sagging of pipes or supports is not acceptable.
- B. Adjustable clevis hangers shall be used for single pipe supports; Anvil Fig. 260. When oversized clevis is used, a nipple shall be placed over the clevis bolt as a spacer to assure that the lower U-strap will not move in on the bolt. Provide adjustable clevis with a nut / washer above and below the hanger on the support rod. Ring type clevis hangers are not acceptable.
- C. Provide Anvil Figure 45 galvanized or primed and painted channel assembly for trapeze hangers.

3.6 PIPE SUPPORTS ON ROOF

- A. Support gas pipe on roof with Portable Pipe Hanger Model PP-10 with roller and fully adjustable height throughout pipe run. Base material shall be high density / high impact polypropylene with UV inhibitors and anti-oxidants. Provide with hot dip galvanized rod finish and framing. Nuts and washers shall be hot dip galvanized.

3.7 ANCHORS

- A. Provide anchors as required. Use pipe anchors consisting of heavy steel collars with lugs and bolts for clamping to pipe and attaching anchor braces. Install anchor braces in the most effective manner to secure desired results. Do not install supports, anchors or similar devices where they will damage construction during installation or because of the weight or the expansion of the pipe. When possible, install sleeves in structural concrete prior to pouring of concrete.

3.8 FLOOR PENETRATIONS

- A. At locations where pipe passes through floors, provide watertight concrete curb around penetration.

3.9 PIPE SLEEVES

- A. Sleeves through masonry and concrete construction:

1. Fabricate sleeves of Schedule 40 galvanized steel pipe.
 2. Size sleeve large enough to allow for movement due to expansion and to provide continuous insulation.
- B. Sleeves through gypsum wall construction.
1. Fabricate sleeves of 16 gauge galvanized sheet metal.
- C. Sleeves through elevated slab construction.
1. Fabricate sleeves of Schedule 40 galvanized steel pipe with welded center flange in floor.
- D. Extend each sleeve through the floor or wall. Cut the sleeve flush with each wall surface. Sleeves through floors shall extend 2" above floor lines for waterproofing purposes. Slab on grade floors shall not be sleeved except where penetrating waterproofing membrane or insect control is required.
- E. Caulk sleeves water and air tight. Seal annular space between pipes and sleeves with mastic compound to make the space water and air tight.
- F. For sleeves below grades in outside walls, provide Thunderline Link-Seal or Advance Product and System Interlynx, with 316 stainless steel nuts and bolts, with cast iron pressure plate.
- G. Provide chrome plated escutcheon plates on pipes passing through walls, floors or ceilings exposed to view. At exterior walls, stainless steel sheet metal is to be used.
- H. For sleeves through fire and smoke rated walls, seal with a UL through-penetration firestop, rated to maintain the integrity of the time rated construction. Install in accordance with the manufacturer's installation instructions. Comply with UL and NFPA standards for the installation of firestops. Refer to Architectural drawings for all fire and smoke rated partitions, walls, floors, etc.

3.10 ISOLATION VALVES

- A. Provide piping systems with line size shutoff valves located at the risers, at main branch connections to mains for equipment, to isolate central plant, and at other locations.

3.11 DRAIN VALVES

- A. Install drain valves at low points of water piping systems so that these systems can be entirely drained. Install a line size drain valve for pipes smaller than 2" unless indicated otherwise. For pipes 2-1/2" and larger, provide 2" drain valves unless indicated otherwise. Drain valves shall be plugged when not in use and at completion.

3.12 CLEANING OF PIPING SYSTEMS

- A. 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.
- B. 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 strainers, remove and clean as frequently as necessary.

- C. Phase One: Initial flushing of system. Remove loose dirt, mill scale, weld beads, rust and other deleterious substances 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.
- D. 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.
- E. Dispose of water in approved manner.
- F. Phase Two: Cleaning of Piping Systems. 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. Flush system and replace with clean water.
- G. Phase Three: Final flushing and rinsing: 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.
- H. Submit status reports upon completion of each phase of work on each system.

3.13 TESTING

- A. Test piping after installation with water hydrostatic pressure of 1-1/2 times operating pressure (150 psig minimum) and carefully check for leaks. Repair leaks and retest system until proven watertight.
- B. Do not insulate or conceal piping systems until tests are satisfactorily complete.
- C. If any leaks or other defects are observed, suspend the test and correct the condition at once. Repeat testing until leaks are eliminated and the full test period is achieved.
- D. The satisfactory completion of testing does not relieve the Contractor of responsibility for ultimate proper and satisfactory operation of piping systems and their accessories.

3.14 PIPE MARKERS

- A. Identify interior exposed piping and piping in accessible chases or plenums with Opti-Code Brady Pressure Sensitive Adhesive Pipe Markers, consisting of pipe marker and direction of flow arrow tape. Clean pipe prior to installation. Background colors of markers, arrows and tape for each type of system shall be the same. Meet ANSI/OSHA standards and clearly identify each system. Provide minimum 2-1/4-inch letters through 4-inch pipe and 4-inch letters for 5-inch pipe and larger.
- B. Identify exterior and mechanical room piping with Snap Around pipe markers through 4-inch pipe and Strap Around markers 5-inch pipe and larger. Pipe markers consisting of pipe marker and direction of flow arrow tape; background colors of markers, arrows and type for each type of system shall be the same. Meet ANSI / OSHA standards and clearly identify each system. Provide minimum 2-1/4-inch letters through 4-inch pipe and 4-inch letters for 5-inch pipe and larger.

- C. Install identification in the following locations:
 - 1. Both sides of penetrations through walls, floors and ceilings.
 - 2. Close to valves or flanges.
 - 3. Intervals on straight pipe runs not to exceed 50 feet
 - 4. Apply marker where view is obstructed.

- D. Pipe markers shall meet or exceed the specifications of the ASME A13.1 "Scheme for Identification of Piping Systems".

END OF SECTION

SECTION 22 33 33 - ELECTRIC WATER HEATER (Commercial ASME)

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Electric water heaters for domestic water systems.

1.2 RELATED WORK

- A. Division 22 Plumbing
 1. Domestic Water Piping.
 2. Plumbing Piping Insulation.
 3. Division 26 Electrical.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Lochinvar.
- B. State.
- C. Rheem / Ruud
- D. A. O. Smith

2.2 PRODUCTS

- A. Provide electric water heaters with kilowatt, recovery ratings, and storage capacities as scheduled on drawings.
- B. Provide an ASME code construction tank designed for 150 psig working pressure. Furnish glass-lined tank. Lining shall be corrosion-resistant.
- C. Furnish factory-assembled, integral units equipped as follows:
 1. Immersion thermostat.
 2. High temperature limit switch (energy cutout).
 3. Low-water cutoff.
 4. Heavy duty UL rated for 100,000 cycles.
 5. Temperature and pressure relief valve.
 6. Anode rod.
- D. Provide heavy-duty, medium watt density elements having nicoloy sheathing and prewired leads.
- E. The entire vessel shall be enclosed in a round steel enclosure with baked enamel finish and shall enclose the tank with R-16 foam insulation.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation shall meet or exceed all applicable federal, state and local requirements,

referenced standards and conform to codes and ordinances of authorities having jurisdiction.

- B. All installations shall be in accordance with the manufacturer's published recommendations.
- C. Furnish all supports required by the equipment included in this Contract.
- D. Provide a 4" thick reinforced concrete housekeeping pad beneath heaters.
- E. Furnish and install all necessary valves, traps, gauges, strainers, unions, etc. to facilitate proper functioning and servicing of equipment.
 - 1. Install a line size shutoff valve in cold water inlet and hot water outlet close to each heater.
 - 2. Provide a temperature gauge in the domestic hot water piping within five feet of outlet to each heater, upstream of all shut-off valves. Size and locate gauges to be easily readable from a standing position.
- F. Provide dielectric isolation device where copper lines connect to ferrous lines or equipment, such as dielectric coupling or dielectric flange fitting.
- G. Route condensate to a vented receiver.
- H. Pipe relief valve discharge and all equipment drains indirectly to appropriate floor drain.
- I. Set the operating and safety controls.
- J. Set thermostats on domestic water heaters to delivery maximum water temperature as indicated on Contract Drawings.
- K. Furnish and install an expansion tank on cold water supply to heater. Locate tank as close to water heater as possible between water heater and all check valves or backflow preventers. Expansion tank capacity shall be as scheduled on Contract Drawings. Install expansion tank in accordance with manufacturer's recommendations.
- L. Install water heater in galvanized drain pan piped to floor drain. Elevate water heater tank bottom above drain pan as to not allow standing water inside of drain pan to touch bottom of tank.

3.2 STARTUP

- A. Startup shall be performed by factory trained and authorized personnel. The factory representative shall also provide a technical and practical operation and maintenance training seminar including a hands-on operation and maintenance demonstration, and classroom presentation with handouts and visual aids, for no less than three physical plant personnel.

END OF SECTION

SECTION 22 34 32 - GAS-FIRED DOMESTIC WATER HEATER (Cyclone)

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Gas-fired domestic hot water heating systems, including hot water heaters, storage tanks, control valves, and pressure and temperature relief valves, as required.

1.2 RELATED ITEMS

- A. Division 22 Plumbing:
 - 1. Domestic Water Piping
 - 2. Gas Piping
 - 3. Flue Piping
 - 4. Plumbing Piping Insulation

1.3 CERTIFICATION

- A. Provide water heater listed by UL Laboratories, according to ANSZ21.10 Standards governing storage-type water heaters. Must meet ASHRAE/IESNA 90.1-1999 and be design-certified by Underwriter's Laboratories for 180°F water. Must meet SCAQMD Rule 1146.2 for low-nox emissions.

PART 2 - PRODUCTS

2.1 CAPACITY

- A. Water heaters shall have the storage capacity and gallons per hour recovery at 100°F rise as scheduled.

2.2 TANK

- A. Construct the tank with a 125 psi ASME rating in accordance with the ASME Code, Section IV. Tank shall have a seamless glass-lined steel tank construction.
- B. Powered Anodes.

2.3 BURNER

- A. A spiral-shaped heat exchanger placed entirely inside the tank which shall be glass-lined on the flue gas side to protect against acidic flue gas condensate.
- B. Heater shall have a down-fired power burner designed for precise mixing of air and gas for optimum efficiency, requiring no special calibration on start-up.

2.4 INSULATION

- A. Insulate the water heater with factory applied foam insulation and trim with a heavy-gauge, enameled steel jacket.

2.5 CONTROLS

- A. Furnish 120V controls for heaters of 100,000 BTUH and above. Controls shall be an integrated solid-state temperature and ignition control device with integral diagnostics, LED fault display capability, and a digital display of temperature system.

GAS-FIRED DOMESTIC WATER HEATER (Cyclone)

223432-1

Salas O'Brien Registration #F-4111

2.6 FLUE

- A. This water heater(s) shall be suitable for sealed combustion direct-venting with 4" diameter PVC air intake pipe and 4" diameter PVC exhaust pipe for a total of 70 feet of intake and 70 feet of exhaust. Provide a properly sized thermal expansion tank as scheduled on drawings. Refer to manufacturer's installation instructions for material types used in air intake and exhaust pipe use.

2.7 CARBON MONOXIDE MONITORING SYSTEM

- A. Provide and install a manual reset Carbon Monoxide Detector located within the boiler room when combustion air is ducted to boilers. The Carbon Monoxide Detector and the boilers shall be interlocked so that the burners will not operate when the level of CO in the room rises above 50ppm. The Carbon Monoxide detector shall disable the boiler's burner upon loss of power to the detector.
- B. Carbon Monoxide Sensor with two year warranty by U.S. Draft Co. Model CGM-605 with model XB expansion module.
 - 1. Provided with pre-programmed dry contacts to shut down equipment during unsafe operation.
 - 2. NEMA 1 Enclosure
 - 3. Complies with Texas State Boiler Code 65.603-2015
 - 4. Additional features shall include 0-10 VDC control signal out, visual alarm and audible alarm.
 - 5. Provide expansion board for additional equipment interlocks.

2.8 ACCEPTABLE MANUFACTURERS

- A. A.O. Smith
- B. State
- C. Lochinvar
- D. Bock
- E. Rheem/Ruud
- F. PVI
- G. HTP

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install a line size valve in the cold water supply close to each heater and a line size plug cock in the gas supply close to each heater.
- B. Provide approved dielectric couplings at all cold water and hot water connections to storage tank, and at pressure and temperature relief valve connection.
- C. Install according to manufacturer's specifications and pipe as shown.
- D. Install water heater in galvanized drain pan piped to floor drain. Provide 3/4" outlet

connection. Elevate water heater tank bottom above drain pan as to not allow standing water inside of drain pan to touch bottom of tank.

- E. Provide and install acid neutralization box for each heater on condensate from exhaust vent.

3.2 STARTUP

- A. Startup shall be performed by factory trained and authorized personnel. The factory representative shall also provide a technical and practical operation and maintenance training seminar including a hands-on operation and maintenance demonstration, and classroom presentation with handouts and visual aids, for no less than three physical plant personnel.
- B. Startup procedure shall include a functional test of Carbon Monoxide Detector. Simulate an alarm condition and demonstrate the functionality of the detector shutting down the appliances. Owner / Engineer shall be present to witness test.

3.3 WARRANTY

- A. Provide standard manufacturer's 1 year commercial warranty for mechanical and electrical and 5 year warranty for leaks. Warranty shall start the date of the substantial completion certificate.

END OF SECTION

SECTION 22 40 00 - PLUMBING FIXTURES AND FIXTURE CARRIERS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish and install water closets, urinals, lavatories, electric drinking fountains, fixture carriers and plumbing appurtenances.

1.2 RELATED WORK

- A. Division 22 Plumbing
 1. Drains, Hydrants and Cleanouts.
 2. Domestic Water Piping.
 3. Soil, Waste and Sanitary Drain Piping and Vent Piping.

1.3 JOB REQUIREMENTS

- A. Furnish plumbing fixtures and trim as shown and specified. Provide faucets, fittings, supply stops and similar devices of a single manufacturer. Furnish faucets and supply stops with renewable seats. Porcelain to steel and enameled cast iron fixtures shall be acid resistant. Wall hung fixtures shall be installed with a fixture carrier.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Plumbing Fixtures (Vitreous China):
 1. American Standard.
 2. Kohler.
 3. Toto
 4. Zurn
 5. Sloan
- B. Plumbing Faucets:
 1. Chicago
 2. T&S Brass (Manual Faucets only)
 3. American Standard
 4. Moen Commercial
 5. Zurn
- C. Supports and Carriers:
 1. Josam
 2. Zurn
 3. J.R. Smith.
 4. Wade
 5. Watts
- D. Flush Valves:
 1. Sloan "Royal"
 2. Zurn "XL"
 3. Toto "TMT1HNC-32"
 4. Moen Commercial
- E. Supplies, Stops and Chrome Plated Tubular Brass:
 1. McGuire

- 2. T&S Brass
- F. Water Closet Seats:
 - 1. Beneke
 - 2. Church
 - 3. Olsonite
 - 4. Bemis
 - 5. Centoco
- G. Electric Drinking Fountains: (Stainless Steel Only)
(No electronic solenoid valves; only mechanically operated valves.)(No Filtered Units)
 - 1. Halsey Taylor
 - 2. Elkay
- H. Electric Drinking Fountains (Stainless Steel Only) (Bi-Level with Bottle Filler)
 - 1. Halsey Taylor Model HTHBHVR8BL-NF, no filter.
- I. Floor Drains:
 - 1. Josam
 - 2. Zurn
 - 3. J.R. Smith
 - 4. Wade
 - 5. Watts
- J. Cleanouts:
 - 1. Josam
 - 2. Zurn
 - 3. J.R. Smith
 - 4. Wade
 - 5. Watts
- K. Stainless Steel Sinks:
 - 1. Elkay
 - 2. Moen Commercial
- L. Mop Sinks:
 - 1. Crane Fiat
 - 2. Stern Williams
 - 3. Mustee
- M. Roof Drains:
 - 1. Josam
 - 2. Zurn
 - 3. J.R. Smith
 - 4. Wade
 - 5. Watts
- N. Thermostatic Mixing Valves
 - 1. Symmons
 - 2. Leonard
- O. Emergency Safety Equipment
 - 1. Bradley
 - 2. Encon
 - 3. Chicago

- P. Shock Arrestors:
 - 1. Precision Products

- Q. Backflow Preventors
 - 1. Apollo RPLF 4A Series for 2-1/2 inch and larger
 - 2. Febco
 - 3. Watts

- R. Hose Bibbs
 - 1. Wade
 - 2. Chicago
 - 3. Josam
 - 4. Woodford
 - 5. Zurn
 - 6. J.R. Smith

- S. Wall Hydrants
 - 1. Wade
 - 2. Woodford
 - 3. Zurn
 - 4. J.R. Smith
 - 5. Josam

- T. Solids Interceptors & Hair/Lint Traps
 - 1. Watts
 - 2. J.R. Smith
 - 3. Zurn

- U. Trap Primers
 - 1. Precision Plumbing Products (All Brass construction)

- V. Urinal Strainers
 - 1. American Standard Washbrook FloWise Vandal Resistant Strainer #7381408-200.002A
Note: Urinals must accommodate this strainer.

- W. Roof Hydrants
 - 1. Mapa Products Model MPH-24-FP:24/9
Note: Roof hydrants with a drain connection are not allowed.

2.2 REQUIREMENTS

- A. Refer to the drawings for equipment to be supplied.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation shall be in accordance with the manufacturer's instructions.
- B. Make rough-in and final connection of service to each fixture provided under this Section and other Sections or Architectural or Plumbing Drawings.
- C. Provide necessary stops, valves, traps, unions, vents, cold water, hot water, sanitary, etc. for a complete installation.

- D. Provide isolation valves in domestic water lines to isolate all equipment, restrooms, hose bibbs, and where shown on drawings.
- E. Remove piping and services roughed-in incorrectly and install correctly, without cost.
- F. Exposed piping, fittings and appurtenances shall be chrome-plated brass.
- G. Coordinate with the Contractor for locations and service required for each plumbing fixture.
- H. All floor drains and floor sinks shall have trap primer connections. Provide trap primer valves and 1/2-inch water line to each floor drain connection. Trap primer supply line shall have ball valve and Y strainer on inlet side of trap primer valve to facilitate cleaning.
- I. All floor drains and floor sink locations are to be coordinated with all equipment. Locate drains in mechanical equipment spaces to conform to drain locations of equipment furnished. Coordinate drain location with food service equipment and Architectural Drawings.
- J. All floor drains, floor sinks and cleanout covers are to be provided with stainless steel screws. (No Vandal Resistant Screws)
- K. Trap primer valves installed in concealed spaces shall have approved access doors for accessibility.

END OF SECTION

SECTION 22 60 01 - ACID WASTE PIPING AND APPURTENANCES

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Acid waste and vent piping.
- B. Acid neutralization basin.

1.2 RELATED WORK

- A. Piping and fittings.
- B. Piping hangers.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Pipe and Pipe Fittings: For all locations below grade or below slab, above slab in fire rated concealed areas, and exposed below casework (not in return plenum). For all locations above slab in fire rated concealed areas (in return air plenum).
 - 1. CPVC Schedule 40 pipe and DWV fittings for chemical waste drain applications, with solvent welded joints.
 - a. Charlotte Pipe "Chemdrain"
 - b. Spears

PART 3 - EXECUTION

3.1 ACID WASTE AND VENT PIPING

- A. Pipe and Pipe Fittings: For all locations below grade or below slab, above slab, for all areas in return air plenum and not in return air plenums:
 - 1. All pipe, fittings and solvent cement shall be manufactured as a system, to be the product of one manufacturer and manufactured in the United States. All pipe and fittings shall conform to (NSF) 14.
 - 2. Special drainage systems for corrosive chemical or acid waste shall be manufactured from CPVC Type IV, Grade I, ASTM Cell Class 23447. All system components shall be certified by NSF International for use in chemical waste drain systems and bear the mark NSF-cw. All system piping shall be Schedule 40 CPVC produced to the dimensional requirements of ASTM F 2618 and the manufacturer's specifications. All pipe fittings shall be CPVC drainage patterns meeting the requirements of ASTM F 2618 and the manufacturer's specifications.
 - 3. Installation shall comply with the latest installation instructions published by manufacturer and shall conform to all local plumbing, fire and building code requirements. Buried pipe shall be installed in accordance with ASTM D2321 and ASTM F 1668. Solvent welded joints shall be made with ChemDrain One-Step solvent cement conforming to ASTM F493.
 - 4. Referenced Standards:

| | |
|-------------|--|
| ASTM D 1784 | Rigid CPVC Vinyl Compounds |
| ASTM D2321 | Underground Installation of Thermoplastic Pipe (non-pressure applications) |
| ASTM F493 | Solvent Cements for CPVC Pipe and Fitting |
| ASTM F 1668 | Procedures for Buried Plastic Pipe |
| ASTM F 2618 | Standard for Chlorinated Poly (Vinyl Chloride) |

NSF Standard 14
Materials

Chemical Waste Drainage Systems
Plastic Piping Components and Related

3.2 ACID WASTE CLEANOUTS

- A. Floor Cleanouts: Provide cleanout plug below floor level with the same material as acid waste pipe. Install floor access housing similar to George Fischer Model #5277 15A. Install cleanouts where acid waste lines change direction.
- B. Wall Cleanouts: Provide cleanout plug (of the same material as piping system, in wall cavity. Install square access cover and frame similar to Mifab C1460-S-3-6.

3.3 ACID WASTE AND VENT PIPING

- A. Install at minimum slope 1/8 inch per foot.
- B. Follow manufacturer's recommendations for support and burial.
- C. Flush, fill with water and let stand for 24 hours. Repair leaks and repeat procedure until leak free.

END OF SECTION

SECTION 22 63 11 - GAS PIPING AND APPURTENANCES

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish and install steel gas pipe inside buildings, including the supply line from the meter, service lines to gas equipment and appliances, termination of the service line with a plug valve, drip leg, and final connection to equipment and appliances with unions.
- B. Coordinate service line from utility main and extend to meter. Coordinate installation of the service line and meter with Gas Company.
- C. Extend steel gas piping from meter to inside the building to all fixtures, appliances and equipment requiring gas.

1.2 RELATED WORK

- A. Division 22 Plumbing
 - 1. Plumbing Pipe and Fittings
 - 2. Valves and Vents

1.3 UTILITY CONNECTIONS

- A. Make arrangements for and pay all fees and connection charges for obtaining service to the building.

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS - ABOVE GRADE

- A. Pipe 2 inch and Smaller:
 - 1. Schedule 40 ASTM A 53 black steel pipe
 - 2. Factory fabricated socket weld fittings.
- B. Pipe Larger than 2 inch:
 - 1. Schedule 40 ASTM A 53 black steel pipe.
 - 2. Factory fabricated butt weld fittings for welded steel pipes shall conform to ASTM A-234 WPB (seamless weld fittings).
- C. Unions:
 - 1. Standard 150 lb. (300 lb. water, oil or gas) malleable iron.
 - 2. Ground joint unions, with bronze seat.
 - 3. Flange joints for pipe larger than 2 inch in diameter.
- D. Flanges:
 - 1. Steel flanges. ANSI B16.5 and ASTM A-105.

2.2 PIPE AND FITTINGS - IN UTILITY TRENCH TO ISLAND LAB TABLES

- A. Pipe as specified in paragraph 2.1 above, run in utility trench similar to ABT, Inc., Polyduct Utility Trench, 39.2 inch long sections x 12 inches wide x 7 inches deep rectangular polymer concrete, non-sloping, flat bottom, solid cover steel floor plate bolted to unitized frame.

2.3 VALVES

- A. See Section 22 05 23.

2.4 GAS PRESSURE REGULATOR

- A. Size the gas pressure regulator in accordance with the manufacturer's recommendations for flow quantities and reduced pressure as required for all equipment. Coordinate final equipment gas pressure requirements prior to ordering regulators. Provide American Meter Company regulators or approved equal, suitable for outdoor installation. Regulators outside exposed to weather shall be installed with vent in vertical down position.
- B. All line pressure regulators shall be listed in accordance with ANSI (American National Standard) Z21.80 and CSA (Canadian Standards Association Standard) 6.22.
- C. Emergency shut off for science classrooms; color: yellow.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation Standards: Install gas piping in accordance with recommendations of the National Fire Protection Association.
- B. Drip Legs: Install a capped drip leg 6 inches long at the base of each vertical rise.
- C. Coating and Wrapping. Coat and wrap underground piping in accordance with the service utility company standards.
- D. Sleeves.
 - 1. Encase gas piping running in or through solid partitions with thin wall metal conduit. Sleeve piping and fittings shall be two pipe sizes, but not less than 1 inch larger than encased gas piping.
 - 2. Encase gas piping running below slab in Schedule 40 PVC, minimum size two pipe sizes larger than gas pipe. Vent sleeve to atmosphere with a 1-1/2 inch vent with 1-1/2 inch return bend above building roof. Seal ends of sleeve with UL fire rated caulk.
- E. Do not install gas piping exposed to view inside public area, or occupied spaces, without prior written approval.
- F. Weld all gas piping above grade.
- G. Provide test ports and isolation valves to enable proper testing of system in the future.
- H. Provide isolation valve and unions across regulators for proper removal.
- I. Provide transition risers where below grade polyethylene pipe changes to steel pipe above grade.
- J. Gas Pressure Regulators / Vents:
 - 1. Piping shall be sized in accordance with the regulator manufacturer's instructions. Never use pipe sizes smaller than the vent size; smaller pipe sizes restrict the gas flow. Where there is more than one regulator at a location, each regulator shall have a separate vent to the roof / outdoors. Headers with various installed devices can cause regulator malfunction.

2. Support the vent pipe to eliminate strain on the regulator diaphragm case.
3. Install vent piping from regulators to location to prevent gas smells from entering building. Do not locate the vent line terminus near windows, fans, or other ventilation equipment. See the installation instructions furnished with the regulator.
4. Install double elbows and insect screen at end of piping to prevent moisture and insects from entering. Always point outdoor vent pipes in the downward position to reduce the possibility of rain, snow, sleet, and other moisture entering the pipe.
5. When installed inside building route vents horizontally and terminate through building sidewall. The vent must be piped to the outside atmosphere using the shortest length of pipe, the fewest possible pipe elbows, and a pipe diameter as large as the vent size or larger. If a long gas run must be used, increase the pipe one nominal size every ten feet to keep the flow restriction as low as possible. Vents terminating through roof must have prior approval from Architect before installation. Through roof penetrations shall be minimized.
6. Regulators installed outside or on roof top: Install regulator vent turned downward with insect screen over vent opening. The vent shall be designed to prevent the entry of water, insects, or other foreign materials that could cause blockage.
7. Ensure the end of the vent line is away from ANY potential ignition sources. It is the installer's responsibility to ensure the vent line is exhausting to a safe environment
8. Adhere to all applicable codes and regulations.

3.2 TESTING GAS PIPING

- A. Preliminary gas test as required by Code, but minimum test pressure of 50 PSI held for not less than eight hours without noticeable drop.
- B. Test joints with a soap solution while lines are under pressure.
- C. Repair leaks.
- D. Final gas test shall be with a diaphragm gauge with a minimum dial size of 3-1/2 inches with a set hand and a pressure range not to exceed twenty (20) psig with 2/10-pound increments. The minimum test pressure shall not be less than ten (10) psi and the maximum test pressure shall not exceed twelve (12) psig. This test will be observed for no less than (30) thirty minutes with no drop in pressure. Final gas test must be witnessed by Cy-Fair ISD Plumbing Department personnel.
- E. Provide copy of gas pressure test reports in Operations & Maintenance Manual.
- F. Provide Railroad Commission of Texas Pipeline Safety Form PS-86B.
 1. To find form online, go to: Texas School Gas Test Form
- G. School renovations projects shall have all gas piping tested. Report and document gas leaks found to the Architect and Engineer. Repair leaks at no additional cost to the Owner.
- H. The District must be notified to witness any gas system test.
- I. Send copy of gas piping material and domestic manufacture for approval to Bill Smith and Shannon Thompson at CFISD. Provide test valve opening downstream of main gas shutoff and meter but before building entry with valve to be Nibco T585-70UL (1/4") with plug cap.

3.3 IDENTIFICATION CONDUCTOR

- A. Spiral A #12 AWG insulated copper conductor the full length of the thermoplastic piping system. Fasten to the pipe at 3 foot intervals with plastic tie wraps.
- B. Terminate at each end in a 12 inch x 12 inch x 4 inch FRP junction box.
 - 1. Bolted gasketed cover with stainless steel screws.
 - 2. Screw type terminal strip.
 - 3. Legend on cover "gas pipe identification conductor."
- C. Set in concrete pad.

3.4 PAINT EXPOSED OUTSIDE GAS PIPE

- A. Interior and Exterior Gas piping shall be protected from rust.
- B. Paint pipe with a flat alkyd coating, clean pipe prior to painting by preparing surface by hand tool cleaning per SSPC-SP2-82, applying one coat of Glidden Y-590 Rustmaster Metal Primer White and top coat of Yellow Alkyd Flat Enamel.

END OF SECTION

SECTION 23 01 00 - HVAC OPERATING AND MAINTENANCE MANUALS

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Compilation product data and related information appropriate for Owner's operation and maintenance of products furnished under Contract. Prepare operating and maintenance data as specified.
- B. Instruct Owner's personnel in operation and maintenance of equipment and systems.
- C. Submit three copies of complete manual in final form.

1.2 SUBMITTALS

- A. Thirty (30) days after the Contractor has received the final scheduled identified submittals bearing the Architect/Engineer's stamp of acceptance (including resubmittals), submit for review one copy of the first draft of the Operating and Maintenance Manual. This copy shall contain as a minimum:
 - 1. Table of Contents for each element.
 - 2. Contractor information.
 - 3. All submittals, coordination drawings and product data, reviewed by the Architect/Engineer; bearing the Architect/Engineer's stamp of acceptance. (When submittals are returned from Engineer "Correct as Noted", corrected inserts shall be included.)
 - 4. All parts and maintenance manuals for items of equipment.
 - 5. Warranties (without starting dates)
 - 6. Certifications that have been completed. Submit forms and outlines of certifications that have not been completed.
 - 7. Operating and maintenance procedures.
 - 8. Form of Owner's Training Program Syllabus (including times and dates).
 - 9. Control operations/equipment wiring diagrams.
 - 10. Schedule of filters for each item of equipment.
 - 11. Schedule of belts for each item of equipment.
 - 12. Other required operating and maintenance information that are complete.
- B. Copy will be returned to the Contractor within 15 days with comments for corrections.
- C. Submit three (3) completed manuals in final form to the Architect/Engineer one day after substantial completion, and prior to Owner's instructions. Include all specified data, test and balance reports, drawings, dated warranties, certificates, reports, along with other materials and information.
- D. The Architect/Engineer will review the manuals for completeness within fifteen (15) days.
- E. The Contractor shall be notified of any missing or omitted materials. The Manuals shall be reworked by the Contractor, as required, in the office of the Architect / Engineer. The manuals will not be retransmitted.
- F. Two (2) complete Manuals will be delivered to the Owner.

PART 2 – PRODUCTS

2.1 BINDERS

- A. Commercial quality black three-ring binders with clear overlay plastic covers.
- B. Minimum ring size: 1".
Maximum ring size: 3".
- C. When multiple binders are used, correlate the data into related groupings.
- D. Label contents on spine and face of binder with full size insert. Label under plastic cover.

PART 3 – EXECUTION

3.1 OPERATION AND MAINTENANCE MANUAL

- A. Form for 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 flyleaf 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. Schedule of filters for each air handling system.
 - k. Schedule of belts for each item of equipment.
 - l. Each Contractor's coordination drawings.
 - m. As installed color coded piping diagrams.
 - n. Charts of valve tag number, with location and function of each valve.

- o. List of original manufacturer's spare parts and recommended quantities to be maintained in storage.
 - p. 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 extended compressor warranty certificates.

END OF SECTION

SECTION 23 05 00 - MECHANICAL GENERAL PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Except as modified in this Section, General Conditions, Supplementary Conditions, applicable provisions of the General Requirements, and other provisions and requirements of the contract documents apply to work of Division 23 Mechanical.
- B. Applicable provisions of this section apply to all sections of Division 23, Mechanical.

1.2 CODE REQUIREMENTS AND FEES

- A. Perform work in accordance with applicable statutes, ordinances, codes and regulations of governmental authorities having jurisdiction.
- B. Mechanical work shall comply with applicable inspection services:
 - 1. Underwriters Laboratories
 - 2. National Fire Protection Association
 - 3. State Health Department
 - 4. Local Municipal Building Inspection Department
 - 5. Texas Department of Licensing & Regulations (ADA)
- C. Resolve any code violations discovered in contract documents with the Engineer prior to award of the contract. After Contract award, any correction or additions necessary for compliance with applicable codes shall be made at no additional cost to the Owner.
- D. This Contractor shall be responsible for being aware of and complying with asbestos NESHAP regulations, as well as all other applicable codes, laws and regulations.
- E. Obtain all permits required.

1.3 CONTRACTOR'S QUALIFICATIONS

- A. An approved contractor for the work under this division shall be:
 - 1. A 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 has served their Owners satisfactorily for not less than 3 years

1.4 REFERENCE SPECIFICATIONS AND STANDARDS

- A. Materials which are specified by reference to Federal Specifications; ASTM, ASME, ANSI, or AWWA Specifications; Federal Standards; or other standard specifications must comply with latest editions, revisions, amendments or supplements in effect on date bids are received. Requirements in reference specifications and standards are minimum for all equipment, material, and work. In instances where specified capacities, size, or other features of equipment, devices, or materials exceed these minimums, meet specified capacities.

1.5 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.

1.6 PROJECT RECORD DOCUMENTS

- A. Maintain at the job site a separate set of white prints (black line) of the contract drawings for the sole purpose of recording the "as-built" changes and diagrams of those portions of work in which actual construction is at variance with the contract drawings. Mark the drawings with a colored pencil. Prepare, as the work progresses and upon completion of work, reproducible drawings clearly indicating locations of various lines, valves, ductwork, traps, equipment, and other pertinent items, as installed. Include flow-line elevation of sewer lines. Record existing and new underground and under slab piping with dimensioned locations and elevations of such piping.
- B. At the conclusion of project, obtain without cost to the Owner, erasable mylars of the original drawings and transfer as-built changes to these. Prior to transmittal of corrected drawings, obtain 3 sets of blue-line prints of each drawing, regardless of whether corrections were necessary and include in the transmittal (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 (reproducible Dayrex mylar film positives) and AutoCad 2014 files on disk (CD Rom).
- C. 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 RECORD 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 mechanical piping and elevation.
 - 7. Indicate exact location of all underground electrical raceways and elevations.
 - 8. Correct schedules to reflect (actual) equipment furnished and manufacturer.
 - 9. Location and size of all ductwork and mechanical piping above ceiling including exact location of isolation of domestic and mechanical valves.
 - 10. Exact location of all electrical equipment in and outside of the building.
 - 11. Exact location of all roof mounted equipment, wall, roof and floor penetrations.
 - 12. Cloud all changes.

1.7 SPACE REQUIREMENTS

- A. Consider space limitations imposed by contiguous work in selection and location of equipment and material. Do not provide equipment or material that is not suitable in this respect.

1.8 RELATION WITH OTHER TRADES

- A. Carefully study all matters and conditions concerning the project. Submit notification of conflict in ample time to prevent unwarranted changes in any work. Review other Divisions of these specifications to determine their requirements.
- B. Because of the complicated relationship of this work to the total project, conscientiously study the relation and cooperate as necessary to accomplish the full intent of the documents.
- C. Provide sleeves and inserts in forms as required for the work. Stub up and protect open

ends of pipe before any concrete is placed. Furnish sizes of required equipment pads. Furnish and locate bolts and fittings required to be cast in them.

- D. Locate and size openings required for installation of work specified in this Division in sufficient time to prevent delay in the work.
- E. Refer to other Divisions of the specifications for the scope of required connections to equipment furnished under that Division. Determine from the Contractor for the various trades, the Owner, and by direction from the Architect/Engineer, the exact location of all items.

1.9 CONCEALED AND EXPOSED WORK

- A. When the word "concealed" is used in connection with insulating, painting, piping, ducts and the like, the work is understood to mean hidden from sight as in chases, furred spaces or above ceilings. "Exposed" is understood to mean open to view.

1.10 GUARANTEE

- A. Guarantee work for 1 year from the date of substantial completion of the project. During that period make good any faults or imperfections that may arise due to defects or omissions in material, equipment or workmanship. At the Owner's option, replacement of failed parts or equipment shall be provided.

1.11 MATERIAL AND EQUIPMENT

- A. Furnish new and unused materials and equipment meeting the requirements of the paragraph specifying acceptable manufacturers. Where two or more units of the same type or class of equipment are required, provide units of a single manufacturer.

1.12 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 building structure by equipment, piping, ducts or other parts of work, rectify such conditions at no additional cost. If the item of equipment is judged to produce objectionable noise or vibration, demonstrate at no additional cost that equipment performs within designated limits on a vibration chart.

1.13 ACCEPTABLE MANUFACTURERS

- A. Manufacturers names and catalog number specified under sections of Division 23 are used to establish standards of design, performance, quality and serviceability and not to limit competition. Equipment of similar design, equal to that specified, manufactured by a named manufacturer will be acceptable on approval. A request for prior approval of equipment not listed must be submitted ten (10) days before bid due date. Submit complete design and performance data to the Engineer.

1.14 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 ensure proper sequencing and operation throughout the range of operation. Tests shall be made in the presence of the Architect/Engineer. Make adjustments as required to ensure proper functioning of all systems. Special tests on individual systems are specified under individual sections. Submit 3 copies of all certifications and test reports adequately in advance of completion

of the work to allow for remedial action as required to correct deficiencies discovered in equipment and systems.

1.15 WARRANTIES

- A. Submit 3 copies of all warranties and guarantees for systems, equipment, devices and materials. These shall be included in the Operating and Maintenance Manuals.

1.16 BUILDING CONSTRUCTION

- A. It shall be the responsibility of each sub-contractor to consult the Architectural and Engineering drawings, details, and specifications and thoroughly familiarize himself with the project and all job related requirements. Each sub-contractor shall cooperate with the General Contractor to verify that all piping and other items are placed in the walls, furred spaces, chases, etc., so there will be no delays in the job.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1 OPENINGS

- A. Framed, cast or masonry openings for ductwork, equipment or piping are specified under other divisions. Drawings and layout work for exact size and location of all openings are included under this division.

3.2 AIR FILTERS AND PIPE STRAINERS

- A. Immediately prior to substantial completion of the project, inspect, clean and service air filters and strainers. Replace air filters.

3.3 LUBRICATION, REFRIGERANT AND OIL

- A. Provide a complete charge of correct lubricant for each item of equipment requiring lubrication.
- B. Provide a complete and working charge of proper refrigerant, free of contaminants, into each refrigerant system. After each system has been in operation long enough to ensure completely balanced conditions, check the charge and modify for proper operation as required.
- C. Provide a complete charge of special oil for refrigeration use, suitable for operation with refrigerant, in each system.

3.4 HOUSEKEEPING PADS

- A. Provide equipment housekeeping pads under all floor mounted and ground mounted HVAC equipment, and as shown on the drawings.
- B. Concrete work as specified in Division 3.
- C. Concrete pads:
 - 1. 4" high, rounded edges, minimum 2500 psi unless otherwise indicated on the drawings
 - 2. Chamfer strips at edges and corner of forms.

3. Smooth steel trowel finish.
4. Doweled to existing slab

D. Install concrete curbs around duct penetrations or multiple pipe penetrations.

3.5 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 40 hours dedicated instructor time.
 2. 8 hours on each of 5 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 Operating and Maintenance Manual.

3.6 EQUIPMENT IDENTIFICATION

- A. Provide a laminated engraved plastic nameplate on each piece of equipment and starter.
 1. Designation approved by Architect/Engineer.

2. Equipment includes, but is not limited to, air handling units, fan coil units, variable volume boxes, fans, pumps, boilers and chillers.
 3. Submit schedule of equipment to be included and designations.
- B. Provide nameplates with 1/2" high letters and fastened with epoxy or screws.

3.7 OBSTRUCTIONS

- A. The drawings indicate certain information pertaining to surface and subsurface obstructions which has been taken from available drawings. Such information is not guaranteed, however, as to accuracy of location or complete information.
1. Before any cutting or trenching operations are begun, verify with Owner's representative, utility companies, municipalities, and other interested parties that all available information has been provided.
 2. Should obstruction be encountered, whether shown or not, alter routing of new work, reroute existing lines, remove obstruction where permitted, or otherwise perform whatever work is necessary to satisfy the purpose of the new work and leave existing services and structures in a satisfactory and serviceable condition.
- B. Assume total responsibility for and repair any damage to existing utilities or construction, whether or not such existing facilities are shown.

3.8 PROTECTION

- A. Protect work, equipment, fixtures, and materials. At work completion, work must be clean and in original manufacturer's condition.

3.9 INDOOR AIR QUALITY

- A. All equipment and ductwork shall be installed to allow sufficient space for testing, maintenance, and commissioning functions. Access doors or panels shall be installed in ventilation equipment, ductwork, and plenum enclosures for inspection and cleaning of outdoor air intakes, mixing plenums, up and downstream of coils, filters, drain pans and fans.
- B. Practice source control and eliminate potential contaminants in material selection, installation, and maintenance.
- C. Provide installation and disposal instructions for all materials and chemicals that are potential contaminants.
- D. Obtain and conform to the requirements of the Material Safety Data Sheets (MSDSs) in the use of materials.
- E. Utilize manufacturer's recommendations and provide installation instructions for all chemicals, compounds, and potential contaminants including pre-installation degassing if required.
- F. Ventilate completed building prior to final completion using no less than design outside air for at least 48 hours before occupancy.
- G. Make provisions for controls to prevent the entry of air contaminants into the HVAC air distribution system.
- H. Steps shall be taken to ensure that the HVAC system continues to function effectively and are not damaged or contaminated during construction activities.

END OF SECTION

SECTION 23 05 10 - HVAC CONTRACT QUALITY CONTROL

PART 1 – GENERAL

1.1 WORK INCLUDED

- A. Contract quality control including workmanship, manufacturer's instructions, mock-ups and demonstrations.

1.2 QUALITY CONTROL PROGRAM

- A. Maintain quality control over supervision, subcontractors, suppliers, manufacturers, products, services, site conditions and workmanship to produce work in accordance with contract documents.

1.3 WORKMANSHIP

- A. Comply with industry standards except when more restrictive tolerances or specified requirements indicate more rigid standards or more precise workmanship.
- B. Perform work by persons qualified to produce workmanship of specified quality.
- C. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, and racking. Under no conditions shall material or equipment be suspended from structural bridging.
- D. Provide finishes to match approved samples. All exposed finishes shall be approved by the Architect. Submit color samples as required.

1.4 MANUFACTURER'S INSTRUCTIONS

- A. Comply with instructions in full detail, including each step in sequence.
- B. Should instruction conflict with Contract Documents, request clarification from Architect / Engineer before proceeding.

1.5 MANUFACTURER'S CERTIFICATES

- A. When required in individual Specification Sections, submit manufacturer's certificate in duplicate, certifying that products meet or exceed specified requirements.

1.6 MANUFACTURER'S FIELD SERVICES

- A. When required in individual Specification Sections, manufacturer shall provide qualified personnel to observe:
 - 1. Field conditions.
 - 2. Condition of installation.
 - 3. Quality of workmanship.
 - 4. Start-up of equipment.
 - 5. Testing, adjusting, and balancing of equipment.
- B. Representative shall make written report of observations and recommendations to Architect / Engineer.

1.7 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.

1.8 SCHEDULING OF MOCK-UPS

- A. Schedule demonstration and observation of mock-ups, in phases, with Architect / Engineer.
 - 1. Rough-in.
 - 2. Finish with all appurtenances in place.
 - 3. Insulation installed.
 - 4. Demonstrations.

PART 2 – PRODUCTS

2.1 REFERENCE APPLICABLE SPECIFICATION SECTIONS.

PART 3 – EXECUTION

3.1 AIR HANDLING UNIT

- A. Mock-up an air handling unit, completely installed, including:
 - 1. Piping connections; including thermowells, test stations, test wells and other piping appurtenances.
 - 2. Pipe insulation.
 - 3. Condensate drain piping.
 - 4. Electrical connections.
 - 5. Ductwork beyond the first transition.
 - 6. Control valves and bypass.
 - 7. Cabinet/internal vibration isolation.
 - 8. Block valves and balancing valves.
 - 9. Duct insulation.
 - 10. Instrumentation.
- B. Tests: Air flow at scheduled static pressure.
- C. Demonstrate:
 - 1. Filter accessibility.
 - 2. Accessibility to drain and components for service.
 - 3. Controls sequence.

3.2 DUAL DUCT TERMINAL BOX

- A. Mock-up a Dual Duct Terminal Box completely installed, including:
 - 1. Electrical connections.
 - 2. Duct connection beyond first transition.
 - 3. Cabinet/internal vibration isolation.
 - 4. Suspension system.

- B. Tests: Air flow at scheduled static pressure.
- C. Demonstrate:
 - 1. Control Sequence.
 - 2. Accessibility to components for service.

3.3 HOT AND CHILLED WATER CIRCULATING PUMPS

- A. Mock-up one each system pump, completely installed including:
 - 1. Pump mounted on housekeeping pad.
 - 2. Auxiliary drain pan. (Chilled water only)
 - 3. Piping to a point beyond the complete valve and instrumentation assemblies.
 - 4. Strainers with blowdown.
 - 5. Flexible piping connection.
 - 6. Pipe supports.
 - 7. Pipe insulation.
 - 8. Pump painting.
 - 9. Electrical connections.

3.4 PROTECTION OF EQUIPMENT

- A. 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 a like kind at no additional cost to the Owner.
- B. Adequately protect equipment from damage after delivery to the project. Cover with heavy tarpaulins, drop cloths or other protective coverings as required to protect from plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion.

END OF SECTION

SECTION 23 05 11 - MECHANICAL ALTERATIONS PROJECT PROCEDURES

PART 1 – GENERAL

1.1 WORK INCLUDED

- A. Inspect and service existing equipment and materials that are to remain or to be reused.
- B. Disposal of equipment, materials, or housekeeping pads to be abandoned. Prior to disposal, the Contractor shall verify with the Owner what is to be salvaged by the Owner and what is to become the property of the Contractor.
- C. Handling of equipment and materials to be removed.

1.2 QUALITY ASSURANCE

- A. Coordination with the Owner prior to the disconnection or shutdown of existing equipment, or to the modification of existing operational systems.

1.3 CONTRACT DRAWINGS

- A. There is the possibility that existing conditions and devices are affected by the work indicated on the drawings and called for in the specifications (project manual) which do not appear on the drawings. It is the Contractor's responsibility to visit the site and determine all of the existing conditions and to consider these existing conditions when making and presenting a proposal, to have a complete proposal.

PART 2 – PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Material used to upgrade and repair existing equipment shall conform to that specified.
- B. Material used to upgrade and repair existing equipment shall not void existing warranties or listings of the equipment to be upgraded or repaired.
- C. Material used to upgrade and repair existing equipment shall be new and shall be of the same manufacturer of the existing equipment, shall be acquired through the existing original equipment manufacturer's approved distribution channels, shall have manufacturer's warranties for the new material being used, and shall be listed for the use intended.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Existing materials and equipment indicated on the drawings or in the specifications to be reused shall be inspected for damaged or missing parts. Contractor shall notify the Architect / Engineer, in writing, accordingly.
- B. If using materials specified or shown on the drawing voids or diminishes the warranty or operation of remaining equipment or systems, the Contractor shall notify the Architect / Engineer, in writing.

- C. Verify field measurements, above and underground piping connections and flows.
- D. Demolition Drawings are based on casual field observation, and when available, existing record documents. Report discrepancies to Architect before disturbing existing installation, and immediately after such discrepancies are discovered.
- E. Field verify existing conditions and actual utility uses prior to final connections. Existing drawings may not have been available for all required information. Use pipe inspection camera system to field verify existing sanitary / grease waste connections. Verify actual HVAC supply and return piping connections. Verify flow direction and depth prior to connection to existing plumbing systems.

3.2 APPLICATION

- A. Existing materials and equipment indicated on the drawings or in the specifications to be reused shall be cleaned and reconditioned, including cleaning of piping systems and HVAC coils prior to installation and reuse.
- B. Material and equipment removed that is not to be salvaged for Owner's use or for reuse on the project shall become the property of the Contractor and be removed from the site.
- C. Material or equipment salvaged for Owner's use shall be carefully handled and stored where directed by the Owner or the Architect / Engineer. Relocate material and / or equipment as directed by Owner.
- D. Materials and equipment not indicated to be removed or abandoned shall be reconnected to the new system.
- E. Materials, equipment and housekeeping pads not to be reused or reconnected shall be removed for Owner's review and salvaged by Contractor.
- F. Prior to start of construction, Contractor shall walk areas to be renovated with Owner to identify and document items to be salvaged for Owner's use.
- G. Clean and repair existing materials and equipment that remain or are to be reused.
- H. Contractor shall utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

3.3 SEQUENCE AND SCHEDULE

- A. Coordinate utility service outages with Utility Company, Architect and Owner.
- B. Provide additional or temporary valves, piping, ductwork and connections to maintain existing systems in service during construction.
- C. Existing HVAC and Plumbing Service: Refer to drawings for work in remodeled areas. Where facilities in these areas are to remain in service, any related work to keep the facilities in operation is specified in this Division. Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Obtain permission from Owner at least 48 hours before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area. Maintain

acceptable temperature and humidity control within existing building during renovation activities.

- D. Remove and replace existing Mechanical systems and appurtenances as occasioned by new or remodeled construction. Re-establish service that may be interrupted by remodeled construction.
- E. Refer to other drawings series for work in remodeled areas. Where facilities in these areas are required to remain in service, any related work required to keep these facilities in operation is specified in this Division.
- F. Remove and replace existing piping, grilles, boxes and ductwork coincident with the construction.
- G. Remove or relocate existing piping, grilles, ductwork or housekeeping pads as occasioned by new or remodeled construction. Cap unused HVAC or domestic piping and duct beyond the new finish line.
- H. Relocate all HVAC and or domestic piping, grilles, boxes and ductwork as required to accommodate new work requiring precedence.
- I. Remove concrete housekeeping pad where materials or equipment have been removed.
- J. Remove all known utilities, which do not provide service to the buildings that remain.
- K. Remove existing plumbing or mechanical vent penetrations through roof not to be reused.

3.4 DEMOLITION AND EXTENSION OF EXISTING MECHANICAL WORK

- A. The Contractor shall modify, remove, and/or 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 the property of the Owner, and shall be delivered to such destination as directed by the Owner's representative unless they are not wanted, then it will be the responsibility of this Contractor to remove such items and properly dispose of them. Materials and/or items scheduled for relocation and which are damaged during dismantling or reassembly operations shall be repaired and restored to good operative condition. The Contractor may, at his discretion, and upon approval of the Owner's representative substitute new materials and/or items of like design and quality in lieu of materials and/or items to be relocated.
- B. All items 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 relocations and to restore them 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.
- C. When items scheduled for relocation and/or reuse are found to be in damaged condition before work has been started on dismantling, the Contractor shall call the attention of the Owner's representative to such items and receive further instructions before removal. Items damaged in repositioning operations are the contractor's

responsibility and shall be repaired or replaced by the contractor as approved by the owner's representative, at no additional cost to the Owner.

- D. HVAC, Plumbing, piping, ductwork and appurtenances to be removed, salvaged, or relocated shall be removed to points indicated on the drawings, specified, or acceptable to the Owner's representative. Piping and ductwork 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 disconnected in a safe manner acceptable to the Construction Inspector. All disconnections or connections into the existing facilities shall be done in such a manner as to result in minimum interruption of services to adjacent occupied areas. Services to existing areas or facilities that must remain in operation during the construction period shall not be interrupted without prior specific approval of the Owner's representative hereinbefore specified.
- E. Repair adjacent construction and finishes damaged during demolition and extension work.
- F. Maintain access to mechanical installations that remain active. Modify installation or provide access panel as appropriate.
- G. Extend existing installations using materials and methods compatible with existing mechanical installations, or as specified.
- H. Existing mechanical piping and devices found to need additional hangers installed should be added at no additional cost to the Owner.

3.5 PROTECTION OF THE WORK

- A. Provide adequate temporary support and auxiliary structure as necessary to ensure structural value or integrity of affected portion of work.
- B. Provide devices and methods to protect other portions of work from damage.
- C. Execute fitting and adjustment of products to provide a finished installation to comply with specified products, functions, tolerances and finishes.

3.6 IDENTIFICATION OF EQUIPMENT IN RENOVATED AREAS

- A. Identification of Equipment: Provide new identification of all existing equipment to be reused and located within the renovated areas. Do not include the description "existing". Provide new nameplates for all existing mechanical equipment in renovated areas as specified in Section 23 05 00 Mechanical General Provisions.

3.7 REFRIGERANT DISPOSAL

- A. Contractor shall dispose of refrigerant from all DX equipment including refrigerant piping per OSHA, EPA, Federal, State and Local Codes.

END OF SECTION

SECTION 23 05 12 - SHOP DRAWINGS, COORDINATION DRAWINGS & PRODUCT DATA

PART 1 – GENERAL

1.1 WORK INCLUDED

- A. Prepare submittals as required by these specifications as outlined below.
- B. The term submittal, as used herein, refers to all:
 - 1. Shop Drawings
 - 2. Coordination Drawings
 - 3. Product data
- C. Submittals shall be prepared and produced for:
 - 1. Distribution as specified
 - 2. Inclusion in the Operating and Maintenance Manual, as specified, in the related section

1.2 SHOP DRAWINGS

- A. Present drawings in a clear and thorough manner. Identify details by reference to sheet and detail, schedule, or room numbers shown on Contract Drawings.
- B. Show all dimensions of each item of equipment on a single composite Shop Drawing. Do not submit a series of drawings of components.
- C. Identify field dimensions; show relationship to adjacent features, critical features, work, or products.
- D. Submit shop drawings in plan, elevation and sections, showing equipment in mechanical equipment areas.

1.3 COORDINATION DRAWINGS

- A. Present in a clear and thorough manner. Title each drawing with project name. Identify each element of drawings by reference to sheet number and detail, or room number of contract documents. Minimum drawing scale: $\frac{1}{4}'' = 1'-0''$.
- B. Prepare coordination drawings to coordinate installations for efficient use of available space, for proper sequence of installation, and to resolve conflicts. Coordinate with work specified in other sections and other divisions of the specifications.
- C. For each mechanical room and for each outside equipment pad where equipment is located, submit plan and elevation drawings. Show:
 - 1. Actual mechanical equipment and components to be furnished
 - 2. Service clearance
 - 3. Relationship to other equipment and components
 - 4. Roof drains and leader piping
 - 5. Fire protection piping and equipment
- D. Identify field dimensions. Show relation to adjacent or critical features of work or products.
- E. Related requirements:
 - 1. Ductwork shop drawings

2. Coordination drawing specified in Division 26
- F. Submit shop drawings in plan, elevation and sections, showing equipment in mechanical equipment areas.
- G. Gas piping sketch indicating proposed location of piping prior to proceeding with the installation.

1.4 PRODUCT DATA AND INSTALLATION INSTRUCTION

- A. Submit only pages which are pertinent to the project. All options which are indicated on the product data shall become part of the contract and shall be required whether specified are not.
- B. Mark each copy of standard printed data to identify pertinent products, referenced to specification section and article number.
- C. Show reference standards, performance characteristics and capacities; wiring and piping diagrams and controls; component parts; finishes; dimensions and required clearances.
- D. Modify manufacturer's standard schematic drawings and diagrams to supplement standard information and to provide information specifically applicable to the work. Delete information not applicable.
- E. Mark up a copy of the specifications for the product. Indicate in the margin of each paragraph the following: COMPLY, DO NOT COMPLY, or NOT APPLICABLE. Explain all DO NOT COMPLY statements.
- F. Provide a separate transmittal for each submittal item. Transmittals shall indicate product by specification section name and number. Separate all submittals into appropriate specification section number. Do not combine specification sections.

1.5 MANUFACTURERS INSTRUCTIONS

- A. Submit Manufacturer's instructions for storage, preparation, assembly, installation, start-up, adjusting, calibrating, balancing and finishing.

1.6 CONTRACTOR RESPONSIBILITIES

- A. Review submittals prior to transmittal.
- B. Determine and verify:
 1. Field measurements
 2. Field construction criteria
 3. Manufacturer's catalog numbers
 4. Conformance with requirements of Contract Documents
- C. Coordinate submittals with requirements of the work and of the Contract Documents.
- D. Notify the Architect/Engineer in writing at time of submission of any deviations in the submittals from requirements of the Contract Documents.
- E. Do not fabricate products, or begin work for which submittals are specified, until such submittals have been produced and bear contractor's stamp. Do not fabricate products or begin work scheduled to have submittals reviewed until return of reviewed submittals with Architect / Engineer's acceptance.

- F. Contractor's responsibility for errors and omissions in submittals is not relieved whether Architect / Engineer reviews submittals or not.
- G. Contractor's responsibility for deviations in submittals from requirements of Contract Documents is not relieved whether Architect/Engineer reviews submittals or not, unless Architect / Engineer gives written acceptance of the specific deviations on reviewed documents.
- H. Submittals shall show sufficient data to indicate complete compliance with Contract Documents:
 - 1. Proper sizes and capacities
 - 2. That the item will fit in the available space in a manner that will allow proper service
 - 3. Construction methods, materials and finishes
- I. Schedule submissions at least 15 days before date reviewed submittals will be needed.

1.7 SUBMISSION REQUIREMENTS

- A. Make submittals promptly in accordance with approved schedule, and in such sequence as to cause no delay in the Project or in the work of any other Contractor.
- B. Number of submittals required:
 - 1. Shop Drawings and Coordination Drawings: Submit one reproducible transparency and three opaque reproductions.
 - 2. Product Data: Submit the number of copies which the contractor requires, plus those which will be retained by the Architect/Engineer.
- C. Accompany submittals with transmittal letter, in duplicate, containing:
 - 1. Date
 - 2. Project title and number
 - 3. Contractor's name, address and contact number.
 - 4. The number of each Shop Drawing, Project Datum and Sample submitted
 - 5. Other pertinent data
- D. Submittals shall include:
 - 1. The date of submission
 - 2. The project title and number
 - 3. Contract Identification
 - 4. The names of:
 - a. Contractor
 - b. Subcontractor
 - c. Supplier
 - d. Manufacturer
 - 5. Identification of the product
 - 6. Field dimensions, clearly identified as such
 - 7. Relation to adjacent or critical features of the work or materials
 - 8. Applicable standards, such as ASTM or federal specifications numbers
 - 9. Identification of deviations from contract documents
 - 10. Suitable blank space for General Contractor and Architect/Engineer stamps
 - 11. Contractor's signed and dated Stamp of Approval
- E. Coordinate submittals into logical groupings to facilitate interrelation of the several items:
 - 1. Finishes which involve Architect/Engineer selection of colors, textures or patterns
 - 2. Associated items which require correlation for efficient function or for installation

1.8 SUBMITTAL SPECIFICATION INFORMATION

- A. Every submittal document shall bear the following information as used in the project manual:
 - 1. The related specification section number
 - 2. The exact specification section title
- B. Submittals delivered to the Architect/Engineer without the specified information will not be processed. The Contractor shall bear the risk of all delays, as if no submittal had been delivered.

1.9 RESUBMISSION REQUIREMENTS

- A. Make re-submittals under procedures specified for initial submittals.
 - 1. Indicate that the document or sample is a re-submittal
 - 2. Identify changes made since previous submittals
- B. Indicate any changes which have been made, other than those requested by the Architect / Engineer.

1.10 CONTRACTOR'S STAMP OF APPROVAL

- A. Contractor shall stamp and sign each document certifying to the review of products, field measurements and field construction criteria, and coordination of the information within the submittal with requirements of the work and of Contract Documents.
- B. Contractor's stamp of approval on any submittal shall constitute a representation to Owner and Architect/Engineer that Contractor has either determined and verified all quantities, dimensions, field construction criteria, materials, catalog numbers, and similar data or assumes full responsibility for doing so, and that Contractor has reviewed or coordinated each submittal with the requirements of the work and the Contract Documents.
- C. Do not deliver any submittals to the Architect/Engineer that do not bear the Contractor's stamp of approval and signature.
- D. Submittals delivered to the Architect/Engineer without Contractor's stamp of approval and signature will not be processed. The Contractor shall bear the risk of all delays, as if no submittal had been delivered.

1.11 ARCHITECT / ENGINEER REVIEW OF IDENTIFIED SUBMITTALS

- A. The Architect / Engineer will:
 - 1. Review identified submittals with reasonable promptness and in accordance with schedule
 - 2. Affix stamp and initials or signature, and indicate requirements for re-submittal or approval of submittal
 - 3. Return submittals to Contractor for distribution or for resubmission
- B. Review and approval of submittals will not extend to design data reflected in submittals which is peculiarly within the special expertise of the Contractor or any party dealing directly with the Contractor.
- C. Architect / Engineer's review and approval is only for conformance with the design

- concept of the project and for compliance with the information given in the contract.
1. The review shall not extend to means, methods, sequences, techniques or procedures of construction or to safety precautions or programs incident thereto.
 2. The review shall not extend to review of quantities, dimensions, weights or gauges, fabrication processes or coordination with the work of other trades.

- D. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.

1.12 SUBSTITUTIONS

- A. Do not make requests for substitution employing the procedures of this Section.
- B. The procedure for making a formal request for substitution is specified in Div. 1.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION

SECTION 23 05 13 - ELECTRICAL PROVISIONS OF HVAC WORK

PART 1 – GENERAL

1.1 WORK INCLUDED

- A. Electrical provisions to be provided as mechanical work are indicated in other Division 23 sections, on drawings, and as specified.
- B. Types of work, normally recognized as electrical but provided as mechanical, specified or partially specified in this Section, include but are not necessarily limited to the following:
 - 1. Motors for mechanical equipment.
 - 2. Starters for motors of mechanical equipment, but only where specifically indicated to be furnished integrally with equipment.
 - 3. Wiring from motors to disconnect switches or junction boxes for motors of mechanical equipment, but only where specifically indicated to be furnished integrally with equipment.
 - 4. Wiring of field-mounted float control switches, flow control switches, and similar mechanical-electrical devices provided for mechanical systems, to equipment control panels.
 - 5. Wiring of smoke detectors for shutdown of air handling equipment when a fire alarm system is not included in the project.
 - 6. Wiring of oil pump, vibration and oil level limit switches for cooling towers.
 - 7. Refrigerant monitor/sensor/alarming and field installed visual/audible display alarms.
 - 8. Pipe heat tracing.
 - 9. Cooling tower vibration switch/interlock/reset.
 - 10. Field interlock wiring from chiller: flow switches, pump aux. Contacts, pump start/stop.
 - 11. Power supply 120 VAC and control signal from chiller control panel to condenser water flow control valve installed in piping leaving chiller.
 - 12. Wiring of all related circulating water system chemical treatment devices.
 - a. Low voltage electric contacting water meter
 - b. Solenoid valve/blow-down assembly
 - 13. Radiant heater timer switches and/or thermostats
 - 14. Low Voltage thermostat wiring
 - 15. Wiring for pump motor internal heaters
- C. Refer to Division 23 Controls Sections for related control system wiring.
- D. Refer to Division 23 sections for specific individual mechanical equipment electrical requirements.
- E. Refer to Division 26 sections for motor starters and controls not furnished integrally with mechanical equipment.
- F. Refer to Division 26 sections for junction boxes and disconnect switches required for motors and other electrical units of mechanical equipment.

1.2 RELATED WORK

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Specification Sections, apply to work of this Section.

1.3 QUALITY ASSURANCE

- A. Wherever possible, match elements of electrical provisions of mechanical work with similar elements of electrical work specified in Division 26 sections for electrical work not otherwise specified.
- B. For electrical equipment and products, comply with applicable NEMA standards, and refer to NEMA standards for definitions of terminology. Comply with National Electrical Code (NFPA 70) for workmanship and installation requirements.

1.4 SUBMITTALS

- A. Include in listing of motors, voltage, notation of whether motor starter is furnished or installed integrally with motor or equipment containing motors.

PART 2 – PRODUCTS

2.1 MOTORS

- A. Provide motors for mechanical equipment manufactured by one of the following:
 - 1. Baldor Electric Company.
 - 2. Century Electric Div., Inc.
 - 3. General Electric Co.
 - 4. Louis Allis Div.; Litton Industrial Products, Inc.
 - 5. Lincoln Electric
 - 6. Marathon Electric Mfg. Corp.
 - 7. Reliance Electric Co.
 - 8. Westinghouse Electric Corp.
 - 9. WEG
 - 10. U.S. Motors
- B. Motor Characteristics. Except where more stringent requirements are indicated, and except where required items of mechanical equipment cannot be obtained with fully complying motors, comply with the following requirements for motors of mechanical work:
- C. Temperature Rating. Rated for 40 Degrees C environment with maximum 50 Degrees C temperature rise for continuous duty at full load (Class A Insulation).
- D. Provide each motor capable of making starts as frequently as indicated by automatic control system, and not less than 5 starts per hour for manually controlled motors.
- E. Phases and Current Characteristics. Provide squirrel-cage induction polyphase motors for 3/4hp and larger, and provide capacitor-start single-phase motors for 1/2hp and smaller, except 1/6hp and smaller may, at equipment manufacturer's option, be split-phase type. Coordinate current characteristics with power specified in Division 26 sections, and with individual equipment requirements specified in other Division 23 requirements. For 2-speed motors provide 2 separate windings on polyphase motors. Do not purchase motors until power characteristics available at locations of motors have been confirmed, and until rotation directions have been confirmed.
- F. Service Factor. 1.15 for polyphase motors and 1.35 for single-phase motors.
- G. Motor Construction. Provide general purpose, premium efficiency motors, continuous duty motors, Design "B" except "C" where required for high starting torque.
 - 1. Frames. NEMA #56.

2. Bearings are to be ball or roller bearings with inner and outer shaft seals, regreasable except permanently sealed where motor is inaccessible for regular maintenance. Where belt drives and other drives produce lateral or axial thrust in motor, provide bearings designed to resist thrust loading. Refer to individual section of Division 23 for fractional-hp light-duty motors where sleeve-type bearings are permitted.
 3. Except as indicated, provide open drip-proof motors for indoor use where satisfactorily housed or remotely located during operation, and provide guarded drip-proof motors where exposed to contact by employees or building occupants. Provide weather-protected Type I for outdoor use, Type II where not housed. Refer to individual sections of Division 23 for other enclosure requirements.
 4. Provide built-in thermal overload protection and, where indicated, provide internal sensing device suitable for signaling and stopping motor at starter.
 5. Noise Rating: Provide "Quiet" rating on motors.
- H. All motors shall be premium efficiency.
- I. Provide an inverter duty motor on all equipment that utilizes a variable frequency drive.
- J. Provide TEFC or TEAO motors on all Air Handling Units, Pumps, Supply Fans, Cooling Towers and Fan Coil Units with motors larger than 1 HP.

2.2 EQUIPMENT FABRICATION

- A. Fabricate mechanical equipment for secure mounting of motors and other electrical items included in work. Provide either permanent alignment of motors with equipment, or adjustable mountings as applicable for belt drives, gear drives, special couplings and similar indirect coupling of equipment. Provide safe, secure, durable, and removable guards for motor drives. Arrange for lubrication and similar running-maintenance without removal of guards.

2.3 GENERAL REQUIREMENTS – SHAFT GROUNDING RINGS

- A. All motors operated on variable frequency drives shall be equipped with a maintenance-free, conductive microfiber shaft grounding ring to meet NEMA MG-1, 3.4.4.4.3 requirements, with a minimum of two rows of circumferential microfibers to discharge damaging shaft voltages away from the bearings to ground. SGR's Service Life: Designed to last for service life of motor. Provide AEGIS SGR Conductive MicroFiber Shaft Grounding Ring, or approved equal.
- B. Application Note: Motors up to 100 HP shall be provided with one shaft ground ring installed on either the drive end or non-drive end. Motors over 100 HP shall be provided with an insulated bearing on the non-drive end and a shaft grounding ring on the drive end of the motor with the exception of line contact bearings in the drive end of the machine. In this instance the line contact bearing must be electrically insulated and the AEGIS Bearing Protection Ring installed on the opposite drive end of the motor. Grounding rings shall be provided and installed by the motor manufacturer's recommendations.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install motors on motor mounting systems in accordance with motor manufacturer's instructions, anchored to resist torque, drive thrusts, and other external forces inherent in

mechanical work. Secure sheaves and other drive units to motor shafts with keys and Allen set screws on flat surface of shaft. Unless otherwise indicated, set motor shafts parallel with machine shafts.

- B. Verify voltage with Electrical Plans.
- C. Install all electrical and control conduit into the bottom only of all electrical enclosures for motors, VFD cabinets, control cabinets, chillers, etc. (No top or side cabinet penetrations) Top of electrical enclosure must be kept water tight. Top or side cabinet penetrations will not be accepted inside or outside of the building.
- D. Motor Connections: For motors 10 HP and larger, at the motor connection do not use wire nuts. Provide listed insulated multitap connectors or provide copper alloy split bolt connection, or compression lugs and bolts: insulate connection with Scotch Super 88 vinyl electrical tape over rubber tape.

END OF SECTION

SECTION 23 05 14 - HVAC CONDENSATE DRAIN PIPING SYSTEM

PART 1 – GENERAL

1.1 WORK INCLUDED

- A. Provide and install air conditioning condensate drains.

1.2 RELATED WORK

- A. Division 23 – Mechanical:
 - 1. Insulation
 - 2. Fan/Coil Units
 - 3. Air Handling Units
 - 4. Chilled Water Pumps
 - 5. Air Compressor Storage Tanks
 - 6. Equipment Drain Pans

PART 2 – PRODUCTS

2.1 PIPE MATERIAL

- A. Type “L” copper with drainage pattern fittings.
- B. For Air Handling Units – Schedule 40 Galvanized Steel Pipe.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install the system to facilitate easy removal.
 - 1. Use threaded plugged tee at each change of direction to permit cleaning.
 - 2. Install a cleanout every 50 feet of straight run piping
 - 3. Maintain a positive slope on all piping
- B. Install a water seal trap leg based on the fan pressure.
 - 1. Size the length of the trap leg 1 inch larger than the actual system pressure.
- C. Install traps and cleanout as shown in the drawing details.
 - 1. Confirm requirements with manufacturer's installation instructions

3.2 SIZE PIPE AS SHOWN ON DRAWINGS.

- A. Do not install piping sized smaller than the unit drain connection size.

3.3 SECONDARY DRAINS

- A. Provide secondary drains where required by code, shown on the drawings, or where equipment has secondary drain connections.
- B. Provide secondary drain line to approved location whenever possible.

END OF SECTION

SECTION 23 05 17 - HVAC ACCESS DOORS

PART 1 – GENERAL

1.1 WORK INCLUDED

- A. Furnish and install access doors in wall or ceiling locations as required or shown for access to valves, controls, fire dampers, air distribution devices and other equipment requiring maintenance, adjustment or operation.

PART 2 – PRODUCTS

2.1 NON-FIRE RATED ACCESS DOORS

- A. 16-Gauge frames
- B. 14-gauge steel panels
- C. Continuous fully concealed hinges
- D. Flush screwdriver cam lock & cylinder lock for Owner selection
- E. Automatic closing and latching mechanism
- F. Prime coat finish
- G. Brushed satin stainless steel finish for restroom, kitchen or cafeteria installation
- H. Material suitable for wall and/or ceiling mounting

2.2 FIRE RATED ACCESS DOORS

- A. UL listed, 1-1/2 hour Label "B", access doors
- B. 16-Gauge stainless steel
- C. 20-Gauge insulated sandwich-type door panel.
- D. Two inch thick with fire rated insulation
- E. Continuous fully concealed hinge
- F. Automatic closing and latching mechanism
- G. Knurled knob and recessed key operation for Owner selection
- H. Interior latch release slide for opening from inside
- I. Prime coat finish
- J. Material suitable for wall and/or ceiling mounting

2.3 ACCEPTABLE MANUFACTURERS

- A. Milcor

- B. MIFAB
- C. Acudor
- D. Elmdor

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Access doors specified in Division 23 will be installed by other crafts. Not all required access doors are shown. Coordinate with the Contractor to locate access doors for ease of operation and maintenance of concealed equipment.
- B. Installation shall be in accordance with the manufacturer's printed instructions.
- C. Minimum size required:
 - 1. 36" x 24" for Mechanical HVAC equipment related items
 - 2. 18" x 18" for electrical related items
 - 3. 12" x 12" minimum for Fire and Smoke dampers

END OF SECTION

SECTION 23 05 18 - VARIABLE FREQUENCY INVERTER

PART 1 – GENERAL

1.1 WORK INCLUDED

- A. Furnish and install a variable frequency inverter for the following equipment items.
 - 1. Variable Volume Air Handling Units.

1.2 RELATED WORK

- A. Division 23 Mechanical
 - 1. Electrical Provisions of Mechanical Work.
 - 2. Air Handling Units
 - 3. Building Management Control System Sequences

1.3 COOPERATION WITH OTHER TRADES

- A. Coordinate this work with work under Division 26 Electrical to ensure that intended functions are achieved.
- B. Coordinate the size of the variable frequency inverter with the equipment being served by the inverter. The rated current output amps are to be equal to or greater than motor rated full load amps.

1.4 SUBMITTALS

- A. Submit manufacturer's information and shop drawings as specified.
 - 1. Complete technical details.
 - 2. Dimensions and manufacturer's installation manual.
 - 3. Schematic diagrams of the circuitry and field connections.
 - 4. Manufacturer's start-up manual.

1.5 STANDARDS

- A. UL.
- B. CSA.
- C. ISO 9001
- D. NEC
- E. FCC

1.6 WARRANTY

- A. Provide a three year parts and labor warranty from date of Substantial Completion. Provide warranty in writing to Owner and HVAC supervisor with applicable warranty coverage dates.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. ABB

B. Danfoss Graham

C. Yaskawa

2.2 CABINET

A. The inverter and all accessories shall be provided within a wall mounted UL Listed NEMA 1 enclosure in interior AHU mechanical rooms and in NEMA 12 enclosure with deadsides and removeable, gasketed doors with provisions for locking in all Plant locations and pump rooms. Cabinet shall be constructed of metal for reduction of radio frequency interference (RFI) and electromagnetic frequency interference.

2.3 INTERFERENCE WITH OTHER SYSTEMS

A. The inverter shall be designed and constructed to comply with IEEE Standard 519-1993 with respect to line noise and RFI generation. All units shall generate less than 3% total harmonic distortion back to the incoming power line at the point of common connection with sensitive equipment. A harmonic analysis shall be submitted with the approval drawings to verify compliance with the latest version of IEEE-519 voltage and current distortion limits as shown in Table 1.2 and 10.3 at the point of common coupling (PCC). The PCC shall be defined as the consumer-utility interface or primary side of the main distribution transformer.

B. Dual DC Bus filtered chokes (factory installed and wired in the drive enclosure) equivalent to 5% input line reactors shall be provided to minimize harmonics reflected onto the input line.

1. Shall not interfere with computer and other electronic systems in the building.
2. If not inherently protected, provide a suitable isolation transformer.
3. The system shall not produce spikes on the incoming line.

C. Any inverter that generates sufficient electrical line noise to interfere with the operation of sensitive building equipment shall be field modified or replaced by the inverter supplier at no additional cost to the Owner.

2.4 PROTECTIVE CIRCUITS

A. Provide the following protection:

1. Input line fuses or molded case circuit breaker rated at 100 AIC.
2. Input line noise suppression with MOV's (metal oxide varistors) and snubber circuits. MOV's shall be provided across incoming line terminals, AC input reactors, DC choke filters, and transistors to protect inverter from voltage surges and spikes.
3. Protection of solid state inverter devices by limiting output current to 110% of inverter rating, automatically prevent overcurrent trip due to momentary overload conditions.
4. Current limiting DC buss fuse between input and output sections of inverter.
5. Input overvoltage trip.
6. Input undervoltage (-12%) trip.
7. Instantaneous overcurrent protection of solid state inverter devices.
8. Individual overcurrent protection of solid state inverter devices.
9. Output overvoltage trip.
10. Loss of input phase, phase reversals, or blown fuse.
11. Thermal overload trip for overload protection of solid state devices.
12. Ground fault protection on start-up.
13. Output line to line short circuit protection.

14. Phase to phase short circuit or severe overload conditions of output.
15. Overload of motor.
16. Frequency stall.
17. DC buss high voltage.
18. Control function error.
19. Heatsink over temperature (Max. operating ambient: 122 degrees F)
20. Controller able to operate without a motor or any other equipment connected to the output (To facilitate startup and troubleshooting).
21. Capable of restarting into a rotating motor without component damage.
22. Shut down safely without component failure in the event of a sustained power loss, and will automatically return to normal operation, if start is "on" and power is restored.
23. Shut down safely without component failure in the event of a momentary power loss. Automatically return to normal operation if the start is "on", and normal power is restored. Capable of establishing speed control without shutdown or component failure.
24. Designed for input power contactor opening or closing while control is activated, without damage to the controller.
25. Automatically reset trip resulting from overcurrent, undervoltage, overvoltage, or over temperature, and automatically restart after removal, or correction of the faulty condition.
26. Provide status lights or digital display for indication of failure conditions, and form C relay provided for remote indication. Digital display or status lights to indicate power on, at speed, and drive enabled.
27. Operation and fault diagnostic function circuits shall be built into each inverter that provides information in determining the cause and source of a fault. Diagnostics to provide the following information:
 - a. Operating mode at trip (Accel, Decel, Constant speed).
 - b. Output current at trip.
 - c. Output voltage at trip.
 - d. Additional faults that occurred simultaneously or immediately before displayed tripped.Any drive requiring separate card to provide this information shall provide a diagnostic card for each drive.
28. DC link reactor.
29. Input power disconnect, lockable type.
30. Input power disconnect switch / circuit breaker, with lockable type handle.

2.5 OPERATOR DEVICES

- A. The following operator devices shall be door or remote mounted:
 1. Digital keypad and LCD provided to perform all parameter adjustments, operation monitoring, and operation programming.
 2. Power on indication light.
 3. Flush mounted meters or digital display to indicate output voltage, output frequency, and output current, in percent of maximum 0 to 100%.
 4. Manual/Off/Auto 3 position selector switch (hand-off-auto) and manual speed setting control to provide the following control sequences:
 - a. In automatic mode, controller shall follow an external control signal and respond to remote start-stop contact.
 - b. In manual (hand) mode, controller shall follow speed signal set via door mounted keypad and start/stop switch. Switching from "hand" to "auto" and vice versa shall require a single keystroke to a dedicated changeover key. Inverters requiring multiple keystrokes and/or reprogramming of internal parameters to accomplish changeovers are not acceptable.

- c. An integral "safety interlock" protection shutdown circuit shall be provided for interface with firestats, smoke detectors, high static pressure limit switches, vibration switches, etc.
5. Programmable lockout code to prevent unauthorized programming.
6. Critical frequency avoidance capability (up to 3 resonant points).

2.6 FIELD ADJUSTMENTS

- A. The following shall be adjustable in the field:
 1. Maximum Speed: 0 to 125% adjustable.
 2. Minimum Speed: 0 to 100% adjustable.
 3. Acceleration/deceleration rates: 0 to 3600 sec.
 4. Instantaneous overcurrent trip: 50% to 2000%.
 5. Volts/hertz ratio: Field adjustable to 16 patterns or set for automatic selection of proper V/F load profile to operate motor without overdriving or overloading.
 6. Current limit circuit: 60 to 100%.
 7. Carrier frequency: 6 to 16 KHZ.
 8. Control interface: selectable to follow a 0-5 VDC, 0-10 VDC, 4-20 MA, either direct or indirect acting.
 9. Control signal Bias: 0 to 80 HZ.
 10. Control signal gain: 0 to 80 HZ.
 11. Calibration of remote speed signal: 0 to 80 HZ.

2.7 ELECTRICAL CONSTANT SPEED BYPASS

- A. Provide all components and circuitry necessary to provide manual bypass of the inverter. The bypass package shall be mounted in a cabinet common with the inverter and shall be constructed in such a manner that the inverter can be removed for repair while still operating the motor in the "bypass" mode. Manual bypass shall contain the following:
 1. Two contactors mechanically interlocked via a three position through the door selector switch to provide the following control:
 - a. "Inverter" Mode connects the motor to the output of the inverter.
 - b. "Bypass" Mode connects the motor to the input sine wave power. Transfer must occur with input disconnect open. Motor is protected via thermal overload.
 - c. "Off" Mode disconnects motor from all input power.
 2. A molded case circuit breaker or fused disconnect switch with door interlocked handle (lock out type) that interrupts input power to both the bypass circuitry and the drive.
 3. An input contactor, interlocked with both the thermal motor overload and external safeties which disconnects power to the motor regardless of the mode of operation (either "inverter" or "bypass" mode).
 4. A thermal overload to provide protection of motor in the bypass mode.
 5. A safety interlock circuit that disconnects power to the motor (regardless of the mode of operation – "inverter" or "bypass") in response to a signal from the thermal overload and/or external safety circuits.
 6. Line voltage to 24 volt DC power source, fused per NEC, shall provide power to all bypass control circuits.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Installation as per manufacturer's recommendations and requirements.
 1. Inverter chassis is properly grounded.
 2. Line, Load, Control, and Fire/Safety wiring are installed in separate conduits.

3. Length of wire between Motor and Variable frequency drive shall not exceed 100 feet.
4. Install all electrical and control conduit into the bottom only of VFD cabinet. (No top or side cabinet penetrations)

3.2 MANUFACTURER START-UP SERVICE

- A. Factory trained personnel shall be provided for start-up assistance, minimum (1) day per unit.
 1. The manufacturer shall provide start-up commissioning of the VFD and its optional circuits by a factory certified service technician who is experienced in start-up and repair services. Sales personnel and other agents who are not factory certified shall not be acceptable as commissioning agents.
 2. Start-up services shall include checking for verification of proper operation and installation for the VFD, its options and its interface wiring to the building automation system.
 3. Adjustable devices, components, and assemblies to assure optimum performance.
 4. Make final adjustments to the installed drive to assure proper operation of the fan system. Obtain performance requirements from installer of driven loads.
 5. Assistance will be provided to the Owner (upon request) to determine the optimum capacitance for per factory correction and avoidance of potential resonance problems and will determine optimum line filter required.
 6. A written report, duly signed by the technician detailing set points of adjustable devices, amperages recorded, and any other pertinent data. This information is to be included in the operation and maintenance manual.
- B. Input DC voltage to dry motor windings when motor is not in operation at all locations.

3.3 DEMONSTRATION AND TRAINING

- A. Provide system demonstration to personnel, Owner, and/or Owner's selected representatives. Provide training plan in writing to owner.
- B. Demonstrate operation of controllers in the automatic and manual modes.
- C. Provide a minimum of two days of technical training for the owner's operating and technical staff. Schedule training with Owner's authorized representatives, during normal business hours and not less than 30 days prior to planned session.
- D. Training may be consecutive or random, at Owner's option.

END OF SECTION

SECTION 23 05 19- HVAC PRESSURE AND TEMPERATURE INSTRUMENTS

PART 1 – GENERAL

1.1 WORK INCLUDED

- A. This section specifies gauges, thermometers, wells and/or pressure and temperature test stations to be installed as specified.

1.2 RELATED WORK

- A. Division 23, Mechanical
 - 1. 23 05 00 - Mechanical General Provisions
 - 2. 23 20 00 - Pipe and Pipe Fittings, General
 - 3. 23 05 23 - Valves, Strainers and Vents
 - 4. 23 21 13 - Hot Water and Chilled Water Piping, Valves and Appurtenances

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS - GAUGES AND THERMOMETERS

- A. Trerice
- B. Taylor
- C. Marsh
- D. Weksler
- E. Marshalltown
- F. Weiss
- G. Miljoco

2.2 PRESSURE GAUGES

- A. Case and Ring: 4" type 304 stainless steel; liquid filled case with stainless steel bayonet ring.
- B. Dial: White aluminum with black markings
- C. Window: Clear acrylic
- D. Tube: Phosphor bronze and forged brass socket.
- E. Gauge accuracy: +/- 1% over operating range.

- F. For pulsating service, provide impulse dampers.
- G. Without flange for pipe mounting.
- H. With flange for wall mounting.
- I. Weiss Model: LF44S-1B or equal.

2.3 THERMOMETER WELLS

- A. Brass or type 300 stainless steel. Machined bar stock, 1-piece construction.
- B. Where installed in insulated piping or vessels, provide with extension neck to match insulation thickness.
- C. Provide metal-to-metal contact with bulb chamber for maximum sensitivity.
- D. Wells shall be sized to extend a minimum of 50% into pipe.

2.4 THERMOMETERS IN PIPING SYSTEMS OR VESSELS

- A. Die cast aluminum case with baked epoxy finish.
- B. Adjustable angle 9" scale length.
- C. Clear acrylic window.
- D. Brass stem, length to match well.
- E. Red reading organic spirit filled-in magnifying glass column.
- F. White background with black figures and markings.
- G. Brass stems and union connections.
- H. Accuracy: +/- 1% of scale range.
- I. Range:
 - 1. Hot water lines: 30°F to 240°F.
 - 2. Chilled water lines: 0°F to 100°F or 120°F

2.5 PRESSURE AND TEMPERATURE TEST STATIONS

- A. "Test Station" fitting to receive either a temperature or pressure probe. Fitting shall be solid brass with two valve cores of Nordel.
 - 1. Fitted with a color coded cap strap with gasket.
 - 2. Acceptable Manufacturer: Peterson Equipment Company.

3. Provide with extension neck to match insulation thickness.
- B. Provide to the Owner a fitted case with:
 1. Two 0-100 psi pressure gauges as specified and adapters with 1/8" OD probe.
 2. Four 5" stem pocket testing thermometers.
 - a. Two with range 25°F to 125°F for chilled water and condenser water.
 - b. Two with range 0°F to 220°F for hot water.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install in accordance with drawing details and manufacturer's recommendations.
- B. Provide a ball valve at each gauge.
- C. Locate gauges and thermometers to be easily readable from the floor at a 5'-6" eye level. Use adjustable angle or rigid stem as required. Install gauges in upright position.
- D. Install gauges in the following locations: across pumps, chiller cooler and condenser, storage tanks, heat exchangers.
- E. Test wells for automatic temperature controls shall be furnished by Building Management Control Section and installed by Mechanical Contractor.
- F. Install thermometer in the following locations: Across chiller cooler and condenser, storage tanks, across heat exchangers, across boiler, leaving side of water heater, leaving water side of tempered water valves, common chilled and hot water lines.
 1. Hot water lines: 30°F to 240°F.
 2. Chilled water lines: 0°F to 100°F or 120°F

END OF SECTION

SECTION 23 05 23 - HVAC VALVES, STRAINERS AND VENTS

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. HVAC Valves
- B. Pipe strainer and suction diffusers.

PART 2 – PRODUCTS

2.1 VALVES

- A. Pressure Ratings:
 - 1. Unless otherwise indicated, use valves suitable for 125 minimum psig working steam pressure (WSP) and 450°F.
 - 2. The pressure temperature rating of valves shall be not less than the design criteria applicable to components of the system.
- B. Butterfly Valves
 - 1. Butterfly valves shall conform to MSS-SP67.
 - 2. Liners, inserts and discs shall be suitable for the intended service.
 - 3. Valves shall have a full lug type body designed for installation between ANSI standard flanges, and shall be rated at full working pressure with downstream flange removed.
- C. Balancing Valves
 - 1. Provide balancing valves with:
 - a. Corrosion resistant plug with resilient seal when required.
 - b. O-ring stem seal.
 - c. Permanently lubricated, corrosion resistant bearings.
 - 2. Connections
 - a. Through 2" pipe size use threaded connections.
 - b. For valves 2-1/2" pipe size and larger shall be provided with 150 psig flange connections.
 - 3. Provide each valve with:
 - a. Memory stop.
 - b. Plastic drip cap.
 - c. 1/8" gauge tap.
- D. Ball Valves
 - 1. Provide ball valves with:
 - a. Blowout proof stem.
 - b. Full size port, 316 stainless steel ball and stem.
 - c. Cast bronze body.
 - d. Threaded ends.
 - 2. Seat, seals, thrust washers and packing shall be suitable for the intended service.
 - 3. Service rating:
 - a. 150 psi saturated steam.
 - b. 600 psi WOG.
 - 4. Where piping is insulated, ball valves shall be equipped with 2" extended handles of non-thermal conductive material. Provide a protective sleeve that allows operation of the valve without breaking the vapor seal or disturbing the insulation.
 - 5. Provide with memory stop for balancing valves.

- E. Valve Connections
 - 1. Provide valves suitable to connect to adjoining piping as specified for pipe joints. Use pipe size valves. Sweated joints are not allowed.
 - 2. Thread pipe sizes 2" and smaller.
 - 3. Flange pipe sizes 2-1/2" and larger.
 - 4. Use screw to solder adapters for copper tubing.
 - 5. Use grooved body valves with mechanical grooved jointed piping.

- F. Valve Operators
 - 1. Where butterfly valves are provided:
 - a. Provide gear operators on valves 6" and larger.
 - b. Where valves are located 7' or more above the finished floor in equipment room areas provide chain-operated sheaves. Extend chains to about 5' above floor and hook to clips, arrange to clear walking space.
 - c. Lever lock handle with toothed plate for shut-off service and infinitely adjustable handle with lock and nut and memory stop for throttling service on valves 4" and smaller.
 - d. Provide worm gear operators on discharge side of pumps for balancing, for all sizes of valves.
 - e. All valves 2-1/2" and larger provided by Milwaukee Valve shall be provided with gear operators.

- G. Acceptable Manufacturers
 - 1. Dezurik
 - 2. Crane
 - 3. Nibco
 - 4. Keystone
 - 5. Kitz (Hot Water Only)
 - 6. Milwaukee Valve
 - 7. Keckley

- H. Check Valves
 - 1. Bronze body, 2" and smaller, bronze disc (Teflon disc for steam service), regrinding swing check, screw-in cap, threaded connection.
 - 2. Iron body, 2-1/2" and larger, bronze trim, non-slam: stainless steel pins and springs, and bronze plate or bronze mounted, regrind-renew check, bronze seat ring and disc. Provide either wafer or threaded lug.
 - 3. Acceptable Manufacturers
 - a. Mission Duocheck
 - b. Nibco
 - c. Keystone
 - d. Milwaukee Valve
 - e. Keckley

- I. Provide valves of same manufacturer throughout where possible.

- J. Provide valves with manufacturer's name and manufacturing location, duty and pressure rating clearly marked on outside of body.

- K. Where valves are installed in insulated piping, provide with extended neck so valve operator and stop plate clears the full thickness insulation.

- L. Provide valve, seat and trim materials suitable for the intended service.

- M. Provide memory stops for all valves used for throttling service. Valves for throttling service shall be butterfly, plug, caged or ball type.

2.2 PIPE SYSTEMS STRAINERS

- A. Body:
 - 1. "Y" pattern or basket as shown on the drawings.
 - 2. Line size.
 - 3. Threaded strainer blow down port.
 - 4. ASTM A #126 Class B Cast Iron Body.
- B. Construction:
 - 1. 2" size and smaller with screw connections rated 400 psi WOG.
 - 2. Over 2" size with flanged connections, rated 125 psi WOG.
- C. Fabricate screens of Monel or type 304 stainless steel:
 - 1. With 20 mesh woven wire in piping systems through 2".
 - 2. With 0.045 perforations in piping systems 2-1/2" and 3".
 - 3. With 0.125 perforations in piping systems 4" and larger.
- D. Start-up:
 - 1. Provide an additional fine mesh disposable screen for use during start-up operations.
 - 2. Remove after 30 days.
 - 3. Attach to piping for owners review.
- E. Acceptable Manufacturers
 - 1. Crane
 - 2. Zurn
 - 3. Mueller
 - 4. Armstrong
 - 5. Bell & Gossett
 - 6. Keckley

2.3 SUCTION DIFFUSER

- A. For each pump as shown on the drawing, provide an angle type suction diffuser. Body is to fit both the pump inlet and suction pipe size.
- B. Components:
 - 1. Inlet straightening vanes.
 - 2. Removable end cap.
 - 3. Gauge ports.
 - 4. Threaded strainer blow down port.
 - 5. Adjustable support foot.
 - 6. Removable magnetic insert.
- C. The screen shall be as specified for pipe system strainers.
- D. Provide an additional fine mesh disposable strainer for use during start up operations.
 - 1. Remove after 30 days operation and all flushing is complete.
 - 2. Attach to piping for owners review.
- E. Construction:
 - 1. 2" size and smaller with screw connections rated 400 psi WOG.
 - 2. Over 2" size with flanged connections, rated 125 psi WOG.
- F. Fabricate screens of Monel or type 304 stainless steel:

1. With 20 mesh woven wire in piping systems through 2".
2. With 0.045 perforations in piping systems 2-1/2" and 3".
3. With 0.125 perforations in piping systems 4" and larger.

2.4 VALVE SCHEDULE

- A. Hydronic Service
1. Chilled Water Service
 - a. Ball Valves up to 2": Nibco T-585-70-66 w/Nib-Seal insulated Handle
 - b. Butterfly Valve 2-1/2" and larger: Nibco LD - 2000
Keystone Figure 222
 2. Heating & Condenser Water Service
 - a. Ball Valves up to 2": Nibco T-585-70-66
 - b. Butterfly Valve 2-1/2" and larger: Nibco LD - 2000
Keystone Figure 222
 3. Check Valve:
 - a. Nibco Check Valve: T - 413 - B
 - b. Nibco Check Valve 2-1/2" and larger: F - 918 - B
 - c. Nibco Check Valve 2-1/2" and larger: W - 920 -W (Wafer)
 - d. Keystone Check 2-1/2" and larger: FIQ 810

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install valves with stems upright or horizontal, not inverted.
- B. Install valves for shut-off and isolating service at each piece of equipment, at vertical risers, and where shown on the drawings.
- C. Use butterfly valves and ball valves in circulating water systems, for balancing duty. Provide infinite position gear operator with memory stop.
- D. Provide drain valves at main shut-off valves and low points of piping and apparatus so the systems can be entirely drained.
 1. 1" valve for pipes 6" and larger.
 2. 3/4" valve for pipes smaller than 6".
 3. Terminate with pipe plug.
 4. Drain valves shall be ball valves.
- E. Where valves are installed in insulated pipe, valve operator shall have an insert so the lever or handle will not damage the insulation. Install handles so the lever or handles will not damage the insulation.
- F. Provide clearance for installation of insulation and access to valves.
- G. Provide access where valves are not exposed.
- H. Float valves / stilling wells provided and installed in cooling tower or condenser water basins for water level control. Stilling wells provided around float to prevent turbulence ripples or wind from interference.

3.3 PIPE SYSTEMS STRAINERS

- A. Provide an additional fine mesh disposable strainer for use during start up operations.
 1. Remove after 30 days operation and all flushing is complete.
 2. Attach to piping for owners review.

- B. Provide strainer in supply piping for all coil connections.
- C. Provide strainer in condenser water piping outside near pump and after pump discharge.

3.4 WATER SYSTEM AIR VENTS

- A. Provide manual air vents at high points and at any other air pockets of closed circulating pipe systems. Extend 3/8" hard drawn copper tubing discharge drains to nearest floor or hub drain. Provide 1/4" Ball Valve as specified.
- B. Where high point vents are not readily accessible provide additional valves at vent termination.

END OF SECTION

SECTION 23 05 33 - HVAC PIPE HEAT TRACING

PART 1 – GENERAL

1.1 WORK INCLUDED

- A. Furnish and install a complete industrial, constant wattage, UL listed system of electric pipe heat tracing and controls on all make-up water piping outdoors above grade to prevent freezing. The heat tracing system shall conform to ANSI/IEEE Standard 515-1989.
- B. Protect the pipe, valves, fittings, meters and appurtenances. Apply sufficient cable and overheat thermostat to protect the entire system.

1.2 SUBMITTALS

- A. Submit shop drawings and product data as specified in Section 23 05 12
- B. Submit detailed calculations for length of heat tracing cable per foot of pipe, based on actual length of piping installed.
- C. Submit manufacturer's certified capacity charts with selections plotted thereon.
- D. Submit manufacturer's installation instructions.
- E. Submit full load ampere requirement and voltage for branch circuit.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Raychem Corporation
- B. Thermon Manufacturing Company

2.2 COMPONENTS

- A. Self-regulating heater.
 - 1. The self-regulating heater shall consist of two 16 AWG tinned-copper bus wires embedded in parallel in a self-regulating polymer core that varies its power output to respond to temperature all along its length, allowing the heater to be crossed itself without overheating and to be cut in the field. The heater shall be covered by a radiation cross-linked modified polyolefin dielectric jacket.
 - 2. In order to provide energy conservation, and to prevent overheating, the heater shall have a self-regulating factor of at least 90%.
 - 3. The heater shall operate on a line voltage of 120 VAC without the use of transformers.
 - 4. The heater shall be sized according to the following. The required heater output rating is in watts per foot at 50°F (heater selection based on 1-1/2 inch fiberglass insulation on metal piping).
 - 5. The heater shall be XL-Trace as manufactured by Raychem Corporation or XL-Econotrace as manufactured by Thermon Manufacturing Company.
 - 6. Power connection, end seal, splice and tee kits components shall be applied in the field.

7. The system shall be controlled by an ambient sensing thermostat set at 40°F either directly or through an appropriate contactor.
8. Provide an end-of-circuit voltage indicating light

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install and start up the pipe heat tracing system in accordance with the manufacturer's Installation, Start-up and Service Instructions.
- B. Install the pipe heat tracing cable under the pipe insulation.
- C. Apply "Electrically Traced" signs to the outside of the thermal insulation.
- D. Ground fault protection of the equipment shall be provided per the 1996 National Electrical Code, Article 427-22.
- E. Provide a cast aluminum weatherproof NEMA-4 rated junction box for installation of the cable, with pilot light to indicate operation of the cable.
- F. Use only electrical components as recommended by the manufacturer.

3.2 ELECTRICAL WORK

- A. Furnish and install the wire, conduit and raceway systems required for the automatic operation of the pipe heat tracing system. Conform to the National Electrical Code.
- B. The specified wiring work includes:
 1. Wiring of control instruments between thermostat and junction boxes
 2. Installation of thermostat and junction boxes
 3. Wiring from the heat tracing cable to the junction boxes
- C. Related branch circuit power wiring from the junction box to ground fault type circuit is specified to be provided in Division 26.
- D. Provide devices and appurtenances as specified in Division 26.
- E. Identify each circuit at each terminal with a separate tag.
- F. Color code wires in accordance with IPCEA Standards.
- G. Make all joints and connections with approved mechanical connectors.

3.3 TESTING OF THE PIPE HEAT TRACING SYSTEM

- A. Test the pipe heat tracing system:
 1. Simulate freezing outside air conditions
 2. Measure the amperage draw of the heat tracing system
 3. Compare to the manufacturer's capacity rating of the actual system
 4. After installation and before and after installing the thermal insulation, subject heat to testing using a 1000 VDC megger. Minimum insulation resistance should be between 20 to 1000 megohms regardless of the length.

- B. Submit records of test for approval prior to substantial completion; insert in the Owner's Manual.

END OF SECTION

SECTION 23 05 48 - VIBRATION ISOLATION

PART 1 – GENERAL

1.1 SCOPE

- A. Furnish, install, and adjust vibration isolation.

1.2 RELATED WORK

- A. Division 23 Mechanical.
 - 1. Refer to the Section on Ductwork for flexible connections between fans and ducts.
 - 2. Refer to the Section on Equipment Supports for equipment foundation pads.

1.3 SUBMITTALS

- A. Submit product data showing type, size, load, deflection and other information required. Include clearly outlined procedures for installing and adjusting isolators.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Amber Booth
- B. Kinetics
- C. Mason
- D. Korfund
- E. VSI.
- F. Vibration Eliminator Co., Inc.
- G. Metraflex

2.2 ISOLATOR TYPES

- A. Neoprene mountings shall have a minimum static deflection of 0.35 inches (9mm). All metal surfaces shall be neoprene covered and have friction pads both top and bottom. Bolt holes shall be provided on the bottom and a tapped hole and cap screw on top. Steel rails shall be used above the mountings under equipment such as small vent sets to compensate for the overhang.
- B. Hangers shall consist of rigid steel frames containing minimum 1-1/4 inch (32mm) thick neoprene elements at the top and a steel spring with general characteristics as in specification B 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.

- C. Flexible spherical expansion joints shall employ Peroxide cured EPDM in the covers, tubes and frictioning of the reinforcement. Reinforcement must be DuPont Kevlar. Solid steel rings shall be used within the raised face rubber ends to prevent pullout. No substitutions for the DuPont Kevlar or the solid steel embedded flange rings are acceptable. Sizes 2 inch (50mm) and larger shall have two spheres reinforced with a metal ring between spheres to maintain shape and complete with split ductile iron or steel flanges with hooked or similar interlocks. Sizes 16 inch (400mm) to 24 inch (600mm) may be single sphere. Sizes 3/4 inch (20mm) to 1-1/2 inch (40mm) may have threaded bolted flange assemblies, one sphere and cable retention. 14 inch (300mm) and smaller connectors shall be rated at 250 psi (17 BAR) up to 190°F (88°C) with a uniform drop in allowable pressure to 190 psi (13 BAR) at 250°F (121°C). 16 inch (400mm) and larger connectors are rated 180 psi (12 BAR) at 190°F (88°C) and 135 psi (9 BAR) at 250°F (121°C). Safety factors to burst and flange pullout shall be a minimum of 3/1. All joints must have permanent markings verifying a 5 minute factory test at twice the rated pressure. Concentric reducers to the above specifications may be substituted for equal ended expansion joints.
- High pressure joints shall be substituted for the above where operating pressures are higher than standard. Expansion joints shall be installed in piping gaps equal to the length of the expansion joints under pressure. Control rods need only be used in unanchored piping locations where the manufacturer determines the installation exceeds the pressure requirement without control rods. Control rods are not desirable in seismic work. If control rods are used, they must have 1/2- inch (12mm) thick Neoprene washer bushings large enough in area to take the thrust at 1000 psi (6.9 N/mm⁵) maximum on the washer area. Standard diameter bolt washers are not acceptable.
- 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. All expansion joints shall be installed on the equipment side of the shut off valves.
- Flexible expansion joint device shall be provided with a 5-year warranty against leaks and failure.

- D. Flexible spherical expansion joints shall employ Peroxide cured EPDM in the covers, tubes and frictioning of the reinforcement. Reinforcement must be DuPont Kevlar. Solid steel rings shall be used within the raised face rubber ends to prevent pullout. No substitutions for the DuPont Kevlar or the solid steel embedded flange rings are acceptable. Sizes 2 inch (50mm) and larger shall have two spheres reinforced with a metal ring between spheres to maintain shape and complete with split ductile iron or steel flanges with hooked or similar interlocks. Sizes 16 inch (400mm) to 24 inch (600mm) may be single sphere. Sizes 3/4 inch (20mm) to 1-1/2 inch (40mm) may have threaded bolted flange assemblies, one sphere and cable retention. 14 inch (300mm) and smaller connectors shall be rated at 250 psi (17 BAR) up to 190°F (88°C) with a uniform drop in allowable pressure to 190 psi (13 BAR) at 250°F (121°C). 16 inch (400mm) and larger connectors are rated 180 psi (12 BAR) at 190°F (88°C) and 135 psi (9 BAR) at 250°F (121°C). Safety factors to burst and flange pullout shall be a minimum of 3/1. All joints must have permanent markings verifying a 5 minute factory test at twice the rated pressure. Concentric reducers to the above specifications may be substituted for equal ended expansion joints.

High pressure joints shall be substituted for the above where operating pressures are higher than standard. Expansion joints shall be installed in piping gaps equal to the length of the expansion joints under pressure. Control rods need only be used in unanchored piping locations where the manufacturer determines the installation exceeds the pressure requirement without control rods. Control rods are not desirable in seismic work. If control rods are used, they must have 1/2- inch (12mm) thick Neoprene washer bushings large enough in area to take the thrust at 1000 psi (6.9 N/mm⁵) maximum on the washer area. Standard diameter bolt washers are not acceptable.

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. All expansion joints shall be installed on the equipment side of the shut off valves.

- E. Flexible stainless steel hose shall have stainless steel braid and carbon steel fittings. Sizes 3 inch (75mm) and larger shall be flanged. Smaller sizes shall have male nipples. Hoses shall be installed on the equipment side of the shut-off valves horizontally and parallel to the equipment shafts wherever possible.

2.3 ISOLATOR APPLICATION

| EQUIPMENT | ISOLATOR TYPE | MINIMUM DEFLECTION |
|--------------------------|---------------|--------------------|
| Cooling Towers | A | 0.35" |
| Chiller | A | 0.35" |
| Condensing Units | A | 0.35" |
| In-Line Fans | B | 0.5" |
| Air Handling Units | A | 0.35" |
| Suspended Fan Coil Units | B | 0.5" |

2.4 PIPING ISOLATOR APPLICATIONS

| EQUIPMENT | ISOLATOR TYPE |
|----------------------------|---------------|
| Floor Mounted Pumps | C |
| Suspended Pumps | C |
| Chiller Pipe Connections | D |
| Chiller Refrigerant Relief | E |

2.5 FLEXIBLE CONNECTIONS IN PIPING AT PUMPS

- A. Provide flexible connections at suction and discharge of chilled water, and hot water pumps, piping connections on chillers and where indicated on drawings. Refer to schedule above.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Stock Requirements. The isolation manufacturer's representative shall maintain an adequate stock of springs and isolators of type used so that changes required during construction and installation can be made.
- B. Factory Representation. After installation, furnish factory-trained representative of the isolation manufacturer to check various isolators and report measured versus anticipated

deflection on all isolators. Have the representative certify that isolators have been installed in accordance with manufacturer's recommendations and approved submittals. Provide written report to Engineer indicating compliance prior to final acceptance.

END OF SECTION

SECTION 23 05 93 - TESTING, BALANCING AND ADJUSTING (TAB) OF ENVIRONMENTAL SYSTEMS

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Balance, adjust and test the air distribution system including the exhaust system.
- B. Balance, adjust and test the hydronic system.
- C. Verify and record the duct test results performed by the mechanical contractor.

1.2 RELATED SECTIONS

- A. COORDINATION OF TESTING AND BALANCING

1.3 PAYMENT PROCEDURES

- A. The work of this Section of the Specifications shall be paid directly by the Owner.

1.4 SUBMITTALS

- A. History of the TAB organization.
- B. Agency certification.
- C. Personnel qualifications.
- D. TAB data forms.
- E. Instrumentation list.
- F. Name of the project supervising engineer.
- G. Name and address and contact person of five successfully completed projects of similar size and scope.
- H. To perform required professional services, the balancing agency shall have a minimum of one test and balance engineer certified by the Associated Air Balance Council.

1.5 TAB FIRM QUALIFICATIONS

- A. The organization performing the work shall be a Certified member in good standing of the (AABC) Associated Air Balance Council.
- B. Able to furnish evidence of having contracted for and completed not less than five systems of comparable size and type that have served their Owners satisfactorily for not less than five years.
- C. A specialist in this field and have the personnel, experience, training, skill, and the organization to perform the work.
- D. The balancing agency shall furnish all necessary calibrated instrumentation to adequately perform the specified services. An inventory of all instruments and devices in possession of the balancing agency may be required by the engineer to determine the balancing

agency's performance capability.

- E. The balancing agency shall have operated for a minimum of five years under its current name.
- F. Personnel:
 - 1. The project supervisor shall be a Professional Engineer registered in Texas.
 - a. Extensive knowledge of the work involved.
 - b. At least five years experience conducting tests of the type specified.
 - c. This test and balance engineer shall be responsible for the supervision and certification of the total work herein specified.
 - 2. All work shall be conducted under the direct supervision of the supervising engineer.
 - 3. Technicians shall be trained and experienced in the work they conduct.

1.6 WARRANTY

- A. Provide (AABC) guarantee in writing.
- B. Extended warranty.
 - 1. Include an extended warranty of 2 years after completion of test and balance work, during which time the Architect/Engineer may request a retest or resetting of any outlet or other items as listed in the test report.
 - 2. Provide technicians and instruments to assist the Architect/Engineer in making any tests he may require during this period.
 - 3. The balancing agency shall perform an inspection of the HVAC system during the opposite season from that which the initial adjustments were made. The balancing agency shall make any necessary modifications to the initial adjustments to produce optimum system operation.

PART 2 - PRODUCTS - NOT USED

PART 3 – EXECUTION

3.1 TAB TOLERANCES

- A. The water, outside air, supply air, return air, and exhaust air for each system shall be adjusted to within +/- 5% of the value scheduled on the drawings.

3.2 SITE VISITS

- A. During construction, the balancing agency shall inspect the installation of the piping systems, sheetmetal work, temperature controls, energy management system, and other component parts of the heating, ventilating, and air conditioning systems. One inspection shall take place when 60% of the ductwork is installed and another inspection shall take place when 90% of the equipment is installed. The balancing agency shall submit a brief written report of each inspection to the architect and engineer.
- B. Upon completion of the installation and start-up of the mechanical equipment by the mechanical contractor, the balancing agency shall test and balance the system components to obtain optimum conditions in each conditioned space of the building. If construction deficiencies are encountered that preclude obtaining optimum conditions, and the deficiencies cannot be corrected by the mechanical contractor within a reasonable period of time, the balancing agency shall cease testing and balancing services and advise the architect, engineer, general contractor and owner, in writing, of

the deficiencies.

- C. Note proper piping installation, location of valves, and flow measuring instruments.
- D. Make one series of visits, phased as required by construction progress, prior to installation of the ceiling. Note proper installation of balancing dampers.
- E. Continue the site visits up to completion of project. In each succeeding report, list corrections made from previous reports.

3.3 TESTING INSTRUMENTS

- A. Submit a list of all instruments to be used for the test and balance procedures.
 - 1. Catalog sheets
 - 2. Certificate of last calibration
 - 3. Calibration within a period of six months prior to balancing
- B. Testing equipment shall be in good working order and tested for accuracy prior to start of work.

3.4 COORDINATION WITH OTHER SPECIFICATION SECTIONS

- A. Review the related ductwork shop drawings and piping shop drawings. Make recommendations concerning suitability with respect to the testing, balancing and adjusting work.
- B. Make tests to verify proper placement of the static pressure sensors for the variable air volume fan system control.
- C. In cooperation with the work specified in Building Management and Control System section, a systematic listing of the testing and verification shall be included in the final TAB report. The TAB firm shall provide a laptop computer to operate with the Building Management and Control System. Building Management and Control System shall provide all necessary software and special interface cables, as required, to communicate with the DDC system:
 - 1. Work with the temperature control contractor to ensure the most effective total system operation within the design limitations, and to obtain mutual understanding of the intended control performance.
 - 2. Verify that all control devices are properly connected.
 - 3. Verify that all dampers, valves, and other controlled devices, are operated by the intended controller.
 - 4. Verify that all dampers and valves are in the position indicated by the controller (open, closed or modulating).
 - 5. Verify the integrity of valves and dampers in terms of tightness of close-off and full open positions. This includes dampers in multizone units, terminal boxes and fire/smoke dampers.
 - 6. Observe that all valves are properly installed in piping system in relation to direction of flow and location.
 - 7. Observe the calibration of all controllers.
 - 8. Verify the proper application of all normally opened and normally closed valves.
 - 9. Observe the locations of all thermostats and humidistats for potential erratic operation from outside influences such as sunlight, drafts or cold walls.
 - 10. Observe the location of all sensors to determine whether their position will allow them to sense only the intended temperatures or pressures of the media. Control contractor will relocate as deemed necessary by the Engineer.

11. Verify that the sequence of operation for any control mode is in accordance with the approved shop drawings and specifications. Verify that no simultaneous heating and cooling occurs.
 12. Verify the correct operation of all interlock systems and installation is per the manufacturer recommendations.
 13. Check all dampers for free operation.
 14. Verify that all controller setpoints meet the design intent.
 15. Perform variable volume system verification to assure the system and its components track with changes from full flow to minimum flow.
- D. Upon completion of the testing and balancing, submit three days prior notice that the systems are ready for a running test. A qualified representative of the test and balance organization shall be present, with a representative from the engineers office, to field verify TAB report readings. Specific and random selections of data recorded in the certified test and balance report will be reviewed.

3.5 INSTRUMENT TEST HOLES

- A. When it is required to make holes in the field to measure temperature, static pressure or velocity in the ducts:
1. Drill holes, plug and tape external duct insulation.
 2. Repair damaged insulation to Engineer's approval.

3.6 TESTING THE AIR DISTRIBUTION SYSTEM

- A. The TAB agency shall verify that all ductwork, dampers, grilles, registers, and diffusers have been installed per design and set full open. The TAB agency shall perform the following TAB procedures in accordance with the AABC National Standards and all results shall be recorded in the TAB report:
1. Supply Fans:
 - a. Fan speeds: Test and adjust fan RPM to achieve design CFM requirements.
 - b. Current and Voltage: Test and record motor voltage and amperage, and compare data with the nameplate limits to ensure fan motor is not in or above the service factor.
 - c. Pitot-Tube Traverse: Perform a Pitot-Tube traverse of the main supply and return ducts, as applicable, to obtain total CFM. If a Pitot-Tube traverse is not practical, an explanation of why a traverse was not made must appear on the appropriate data sheet. Measurements must be recorded with an Inclined Manometer or an Inclined/Vertical Manometer.
 - d. Outside Air: Test and adjust the outside air on applicable equipment using a Pitot-Tube traverse. If a Pitot-Tube traverse is not practical, an explanation of why a traverse was not made must appear on the appropriate data sheet. If a traverse is not practical, use the mixed air temperature method, if the inside and outside temperature difference is at least 20°F, or use the difference between Pitot-tube traverse of the supply and return ducts.
 - e. Static Pressure: Test and record system static pressure, including the static pressure profile of each supply fan.
 2. All Other Fans:
 - a. Fan speeds: Test and adjust fan RPM to achieve design CFM requirements.
 - b. Current and Voltage: Test and record motor voltage and amperage, and compare data with the nameplate limits to ensure fan motor is not in or above the service factor.

- c. Pitot-Tube Traverse: Perform a Pitot-Tube traverse of the main return ducts, as applicable, to obtain total CFM. If a Pitot-Tube traverse is not practical, an explanation of why a traverse was not made must appear on the appropriate data sheet. Measurements must be recorded with an Inclined Manometer or an Inclined/Vertical Manometer.
 - d. Static Pressure: Test and record system static pressure, including the static pressure profile of each return fan.
 3. VAV Terminal Units:
 - a. Set and record volume regulators on all terminal boxes to meet design maximum and minimum CFM requirements.
 - b. Identification: Identify the type, location, and size of each terminal unit. This information must be recorded on the terminal box data sheets.
 4. Diffusers, Registers and Grilles:
 - a. Tolerances: Test, adjust, and balance each diffuser, grille, and register to within 5% of design requirements. Minimize drafts. Observe throws are in direction as indicated on drawings.
 5. Coils (including electric coils):
 - a. Air Temperature: Once air flows are set to acceptable limits, take wet bulb (cooling coil only) and dry bulb air temperatures on the entering and leaving side of each coil. Calculate the sensible and latent (cooling coil only) capacity of the coil. Provide information in TAB report.
- B. Record preliminary air handler data, including fan RPM and static pressures across filter, fans and coils.
- C. Perform a velocity traverse of the main supply ducts using a pitot-tube and inclined manometer to establish initial air delivery. Perform a Pitot-tube traverse of main supply and return ducts, as applicable, to obtain total CFM. If a pitot-tube traverse is not practical, a detailed explanation of why a traverse was not made must appear on the appropriate data sheet.
- D. Where air measuring stations are installed, use pitot tube traverse readings to verify and record the correct calibration of the stations output.
- E. Make adjustments in fan RPM and damper settings, as required, to obtain design supply air, return air, and outside air.
- F. Measure and adjust all supply and return branches to design air delivery.
- G. Measure and adjust all diffusers to design air delivery to +/- 5% of design requirements.
- H. Make a set of recordings showing final system conditions.

3.7 TESTING THE HYDRONIC SYSTEMS

- A. The TAB agency shall, as applicable, verify that all hydronic equipment, piping, and coils have been filled and purged; that strainers have been cleaned; that water has been flushed and is in a clean condition, and that all balancing valves (except bypass valves) are set full open. As applicable, check air vents and expansion or compression tank for proper operation. The TAB agency shall perform the following testing and balancing functions in accordance with the AABC National Standards and all results shall be recorded in the TAB report:
1. Record preliminary pump data.
 - a. Pump RPM.
 - b. Pump shut-off differential head.
 - c. Pump operating differential head.

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- d. Check and verify pump alignment.
 - e. Verify impeller diameter.
- B. Adjust balancing valves in the pump discharge lines to obtain design water quantity as read from the manufacturer's pump curve and from a flow meter.
- C. In variable flow systems, the water flow of the pump shall be set at the scheduled gpm, not the total of all the valves. Determine the diversity of the system and balance the individual coils with the maximum pump water quantity flowing in the system.
- D. Balance flow through:
 - 1. Chillers.
 - 2. Coils.
 - 3. Boiler.
 - 4. Pumps
 - 5. Condensers.
 - 6. Cooling tower.
 - 7. Heat Exchanger.
- E. Use flow meters, differential pressures and temperature relationships as required.
- F. Balance by-pass lines to obtain the same pressure drop with systems on by-pass as full flow through the coil including the valve.
- G. Repeat steps, as required, to obtain a final systems balance and make a set of recordings showing final systems conditions.
- H. Pumps:
 - 1. Test and adjust pumps to meet design water flow requirements. Check pumps for proper operation. Pumps shall be free of vibration and cavitation Record appropriate gauge readings for final TDH and Block-Off/Dead head calculations. Check and verify pump alignment.
 - 2. Current and Voltage: Test and record motor voltage and amperage, and compare data with the nameplate limits to ensure pump motor is not in or above the service factor.
- I. Coils:
 - 1. Tolerances: Test, adjust, and balance all chilled water and hot water coils within 5% of design flow requirements.
 - 2. Verification: Verify the type, location, final pressure drop and water quantity (GPM) of each coil. Calculate the actual capacity of all coils. This information shall be recorded on coil data sheets.
- J. Boilers:
 - 1. Verify that boilers have been filled and started by others, and are in operation.
 - 2. Current and Voltage: As applicable, test and record motor voltage and amperage, and compare data with the nameplate limits to ensure motor is not in or above the service factor.
 - 3. Test, adjust and record water flows through water boilers.
 - 4. Test and record water temperature profiles of each boiler.
- K. Chillers:
 - 1. Verify that chillers have been started by the manufacture and are in operation. Test and adjust chiller water flows to within 5% of the design requirements by using a U-TUBE manometer and setting balancing valves.

2. Current and Voltage: Test and record motor voltage and amperage, and compare data with the nameplate limits to ensure compressor motor is not in or above the service factor.
 3. Test and record temperature profiles of each chiller at design water flow.
- L. Cooling towers:
1. Verify that cooling towers have been filled and started by others and are in operation.
 2. Current and Voltage: Test and record motor voltage and amperage, and compare data with the nameplate limits to ensure cooling tower fan motor is not in or above the service factor.
 3. Test and adjust water flows to balance tower cells and flows between towers.
 4. Test and record water temperature profiles of each condenser at design water flow for water and air side operation.
- M. Heat exchangers:
1. Verify that heat exchangers have been filled and started by others, and are in operation.
 2. Test and record temperature and pressure profiles of water and steam heat exchangers.

3.8 EQUIPMENT POWER READINGS

- A. Record the following information for each motor:
1. Equipment designation.
 2. Manufacturer.
 3. Unit model number and serial number and frame.
 4. Motor nameplate horsepower; nameplate voltage; phase and full load amperes.
 5. Heater coil in starter.
 - a. Rating in amperes.
 - b. Manufacturer's recommendation.
 6. Motor RPM/driven equipment RPM.
 7. Power reading (voltage, amperes of all legs at motor terminals).

3.9 BOILERS

- A. Check for proper operation and with operation at near design conditions, record the following:
1. Manufacturer, model number, serial number and nameplate.
 2. If water type, water flow in GPM, entering and leaving water temperature and water pressure drop in feet.
 3. Type of fuel and heating value.
 4. Rate of fuel consumption.
 5. Capacity in MBH.
 6. Efficiency.
 7. Flue gas analysis.
 8. Motor data.
- B. Observe demonstration that all controls and safety devices are functioning properly. Record observations.

3.10 CHILLERS (Water Cooled)

- A. Balance flow of water thru each evaporator and condenser to be within a range of 100% to 110% of design flow with all pumps operating. With only one pump operating, the maximum flow shall not exceed the maximum tube velocity recommended by the

manufacturer.

- B. Verification of safety interlocks and controls are the responsibility of the manufacturer.
- C. With each chiller operating at near design temperature and water flow conditions, measure and record the following:
 - 1. Manufacturer, model number, serial number and all nameplate data.
 - 2. Evaporator water entering temperature, leaving temperature, pressure drop (ft.) and water quantity (GPM).
 - 3. Condenser water entering temperature, leaving temperature, pressure drop (ft.) and water quantity (GPM).
 - 4. Evaporator and condenser refrigerant temperatures and pressures (using instruments furnished with the machine by the manufacturer).
 - 5. Volts and amps for each phase.
 - 6. Power factor.
 - 7. KW input.
 - 8. Tons of cooling.
 - 9. KW per ton of cooling.
- D. Reference chiller specification for additional requirements.

3.10 CHILLERS (Air Cooled)

- A. Balance flow of water through each evaporator to be within a range of 100% to 110% of design flow with all pumps operating. With only one pump operating, the maximum flow shall not exceed the maximum tube velocity recommended by the manufacturer.
- B. Verification of safety interlocks and controls are the responsibility of the manufacturer.
- C. With each chiller operating at near design temperature conditions, measure and record the following:
 - 1. Manufacturer, model number, serial number and all nameplate data.
 - 2. Evaporator water entering temperature, leaving temperature, pressure drop (ft.) and water quantity (GPM).
 - 3. Condenser air entering temperature, leaving temperature.
 - 4. Evaporator and condenser refrigerant temperatures and pressures (using instruments furnished with the machine by the manufacturer).
 - 5. Volts and amps for each phase.
 - 6. Power factor.
 - 7. KW input.
 - 8. Tons of cooling.
 - 9. KW per ton of cooling.
- D. Reference chiller specification for additional requirements.

3.11 TESTING THE VARIABLE AIR VOLUME SYSTEM

- A. All VAV boxes used are to be calibrated to produce the rated air quantity.
- B. Set and record the supply air static pressure controller to provide actual design air flow at the most resistive terminal.
- C. Measure and adjust the design air delivery at the inlet of each VAV box.
- D. Measure and record the air quantity from each VAV box at its maximum flow. Manipulate

the controller to achieve maximum flow.

- E. Reset each box to yield and record minimum primary air flow.
 - 1. DDC controllers record the correction factor required to establish actual desired air quantity as designed.
 - 2. Pneumatic controllers adjust velocity controller as required to establish actual desired air quantity as designed.
- F. If the box is operating with inlet static pressure in excess of the minimum cataloged pressure specified by the manufacturer and is not producing rated air quantity, field adjust the box to produce rated air quantity. Retest until approved results are obtained.
- G. Position the VAV boxes to the proportion of maximum fan air volume to total installed box maximum volume.
- H. Set the fan to deliver the AHUs scheduled design airflow.
- I. Perform and record a total air traverse.
- J. With the system terminal boxes set for full flow or diversity, the system will be delivering the scheduled design CFM with the most restrictive box in control. Make a speed increase if either or both static and volume are low.
- K. Set the boxes to minimum and adjust the inlet vanes and or speed controllers to prevent excessive static in the system.
- L. Coordinate with the work specified in Building Management and Control System on the final location of the sensors for the static pressure controller. Locate in the supply duct far enough from the fan discharge to be truly representative of the average static pressure in the system.
- M. Modulate the fan speed on the supply fan. Adjust as required to coordinate with the static pressure sensing network.
- N. Make a set of recordings showing final system conditions including system duct static pressures and control system setpoint.

3.12 DUCT TEST

- A. Test and Balancing Contractor shall verify and record the duct test results. A copy of the duct test results, as completed, shall be submitted to the engineer for review within five days. Provide a complete report of all the duct test results in the final TAB report.

3.13 DIRECT EXPANSION EQUIPMENT

- A. With each unit operating at near design conditions, measure and record the following:
 - 1. Manufacturer, model number, serial number and all nameplate data.
 - 2. Ambient temperature, condenser discharge temperature.
 - 3. Amperage and voltage for each phase.
 - 4. Leaving and entering air temperatures.
 - 5. Suction and discharge pressures and temperatures.
 - 6. Tons of cooling.
 - 7. Verification that moisture indicator shows dry refrigerant.

3.14 TAB REPORT

- A. The activities described in this specification shall be recorded in a report form; and four individually bound copies shall be provided to the Architect and Engineer. Neatly type and arrange data. Include with the data the date tested, personnel present, weather conditions, nameplate record of the test instruments used and list all measurements taken after all corrections are made to the system. Record all failures and corrective action taken to remedy any incorrect situation. The intent of the final report is to provide a reference of actual operating conditions for the Owner's operations personnel. Provide a "Preface" which shall include a general discussion of the system and any abnormalities or problems encountered.
- B. All measurements and recorded readings (of air, water, electricity, etc.) that appear in the report must have been recorded on site by the permanently employed technicians or engineers of the TAB firm.
- C. Submit reports on forms approved by the engineer that will include the following data as a minimum:
 1. Title Page
 - a. Company Name
 - b. Company Address
 - c. Company telephone number
 - d. Project name
 - e. Project location
 - f. Project Manager
 - g. Project Engineer
 - h. Project Contractor
 - i. Project Identification Number
 2. Summary of the TAB report data
 3. Index
 4. Instrument List
 - a. Instrument
 - b. Manufacturer
 - c. Model
 - d. Serial Number
 - e. Range
 - f. Calibration Date
 - g. What test instrument is to be used for:
 5. Fan Data
 - a. Location
 - b. Manufacturer
 - c. Model
 - d. Air flow, specified and actual
 - e. Total static pressure (total external) specified and actual
 - f. Inlet pressure
 - g. Discharge pressure
 - h. Fan RPM
 6. Return Air/Outside Air Data
 - a. Identification/location
 - b. Design return air flow
 - c. Actual return air flow
 - d. Design outside air flow
 - e. Actual outside air flow
 - f. Return air temperature
 - g. Outside air temperature
 - h. Required mixed air temperature

- I. Actual mixed air temperature
7. Electric Motors
 - a. Manufacturer
 - b. HP/BHP
 - c. Phase, voltage, amperage, nameplate, actual
 - d. PM
 - e. Service Factor
 - f. Starter size, heater elements, rating
8. V-Belt Drive
 - a. Identification/location
 - b. Required driven RPM
 - c. Drive sheave, diameter and RPM
 - d. Belt, size and quantity
 - e. Motor sheave, diameter and RPM
 - f. Center-to-center distance, maximum, minimum and actual
9. Duct Traverse
 - a. System zone/branch
 - b. Duct size
 - c. Area
 - d. Design velocity
 - e. Design air flow
 - f. Test velocity
 - g. Test air flow
 - h. Duct static pressure
 - I. Air correction factor
10. Air Monitoring Station Data
 - a. Identification/location
 - b. System
 - c. Size
 - d. Area
 - e. Design velocity
 - f. Design air flow
 - g. Test velocity
 - h. Test air flow
11. Air Distribution Test Sheet
 - a. Air terminal number
 - b. Room number/location
 - c. Terminal type
 - d. Terminal size
 - e. Correction factor
 - f. Design velocity
 - g. Design air flow
 - h. Test (final) velocity
 - i. Test (final) air flow
12. Pump Data
 - a. Identification/number
 - b. Manufacturer
 - c. Size/model
 - d. Impeller
 - e. Service
 - f. Design flow rate, pressure drop, BHP
 - g. Actual flow rate, pressure drop, BHP
 - h. Discharge pressure
 - I. Suction pressure
 - j. Total operating head pressure

- k. Shut off, discharge and suction pressures
 - l. Shut off, total head pressure
 - m. Pressure differential settings
13. Cooling Coil Data
- a. Identification/number
 - b. Location
 - c. Service
 - d. Manufacturer
 - e. Entering air DB temperature, design and actual
 - f. Entering air WB temperature, design and actual
 - g. Leaving air DB temperature, design and actual
 - h. Leaving air WB temperature, design and actual
 - i. Water pressure flow, design and actual
 - j. Water pressure drop, design and actual
 - k. Entering water temperature, design and actual
 - l. Leaving water temperature, design and actual
 - m. Air pressure drop, design and actual
 - n. Capacity - sensible and latent
14. Heating Coil Data
- a. Identification/number
 - b. Location
 - c. Service
 - d. Manufacturer
 - e. Entering air DB temperature, design and actual
 - f. Leaving air DB temperature, design and actual
 - g. Water pressure flow, design and actual
 - h. Water pressure drop, design and actual
 - i. Entering water temperature, design and actual
 - j. Leaving water temperature, design and actual
 - k. Air pressure drop, design and actual
 - l. Capacity
15. Electric Coil Data
- a. Identification/number
 - b. Location
 - c. Service
 - d. Manufacturer
 - e. Entering air DB temperature, design and actual
 - f. Leaving air DB temperature, design and actual
 - g. Electrical Characteristics
 - h. Capacity
16. Sound Level Report
- a. Location (Location established by the design engineer)
 - b. N C curve for eight (8) bands-equipment off
 - c. N C curve for eight (8) bands-equipment on
17. Vibration Test on equipment having 10 HP motors or greater in size.
- a. Location of points:
 - 1) Fan bearing, drive end
 - 2) Fan bearing, opposite end
 - 3) Motor bearing, center (if applicable)
 - 4) Motor bearing, drive end
 - 5) Motor bearing, opposite end
 - 6) Casing (bottom or top)
 - 7) Casing (side)
 - 8) Duct after flexible connection (discharge)
 - 9) Duct after flexible connection (suction)

- b. Test readings:
 - 1) Horizontal, velocity and displacement
 - 2) Vertical, velocity and displacement
 - 3) Axial, velocity and displacement
- c. Normally acceptable readings, velocity and acceleration
- d. Unusual conditions at time of test
- e. Vibration source (if non-complying)
- 18. Control verification indicating date performed and any abnormalities identified.
 - a. Point Location/Description
 - b. EMS Readout (Setpoint and Actual)
 - c. Actual Readout of all points
 - d. Interlocks
 - e. Safeties
 - f. Variable speed drive tracking with EMS input
 - g. Variable speed drive Bypass operation
 - h. Sequence of operation

END OF SECTION

SECTION 23 05 94 - COORDINATION OF TESTING AND BALANCING

PART 1 - TESTING, BALANCING AND ADJUSTING

1.1 WORK INCLUDED

- A. Balancing and adjusting of the environmental systems is specified in Section 23 05 93.
- B. Coordination of the work is specified in this Section.

PART 2 - PRODUCTS - NOT USED

PART 3 – EXECUTION

3.1 COORDINATION

- A. Bring the work to a state of readiness for testing, balancing, and adjusting.
 - 1. Install air terminal devices.
 - 2. Provide specified filters in air handling equipment. Install clean filters just prior to the start of the test and balance work.
 - 3. Verify lubrication of equipment.
 - 4. Install permanent instrumentation.
 - 5. Clean piping systems and fill with clean water.
 - 6. Complete "Start-up" of equipment.
 - 7. Check rotation and alignment of rotating equipment and tension of belted drives.
 - 8. Verify ratings of overload heaters in motor starters.
 - 9. Verify that safety and operating control set points are as designed and automatic control sequences have been checked.
 - 10. Provide control diagrams and sequence of operation.
 - 11. Collect material for maintenance manuals and prepare one manual especially for use in testing and balancing.
 - 12. Verify that graphic operational data such as start/stop instructions, valve tag schedules, and piping identification schedules have been provided where needed.
 - 13. Verify that equipment and piping identification work has been completed with valve tags, schedules, and piping identification system.
 - 14. Comb out fins on extended-surface heat transfer coils where damaged.
 - 15. Clean all strainers as required.
 - 16. Remove construction strainers after water is cleaned and treated.
 - 17. Remove all temporary filters from HVAC equipment.
 - 18. Provide start-up reports listing all start-up information and manufacturer's information attached.
- B. Provide and install new pulleys and belts as required to effect the correct speed ratio. Adjustments where no belt or pulley change is required, is specified in Section 23 05 93.
- C. Verify that the systems are ready for balancing and adjusting.
- D. Submit a letter stating:
 - 1. The specified pieces of equipment have been checked, started, and adjusted by the manufacturer.
 - 2. Other equipment has been checked and started.
 - 3. The systems have been operated for the specified period of time.
 - 4. The automatic controls system has been adjusted, calibrated, and checked, and is operating as specified.

- E. Provide the services of a technician full time at all times at the project when testing, balancing and adjusting work is being conducted.
- F. Provide instrumentation and services to take readings of the required data for the refrigerant circuits.
- G. Provide and install volume dampers required for balancing by the TAB Contractor.

3.2 START-UP OF EQUIPMENT

- A. Pre-start & Start-up equipment using the procedures as recommended by the manufacturers.
- B. Complete start-up of equipment prior to start of testing & balancing.
- C. Submit start-up procedures as outlined by the manufacturers and complete the "HVAC FAN / AIR HANDLING / START-UP REPORT FORM" to Engineer.

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END OF SECTION

SECTION 23 07 13 - EXTERNAL DUCT INSULATION

PART 1 – GENERAL

1.1 WORK INCLUDED

- A. Furnish and install external insulation on supply, return and outside air ductwork.
- B. External insulation of concealed and exposed ducts is included in this Section. Internal acoustic duct lining is specified under ductwork and not included in this Section.

1.2 RELATED WORK

- A. Division 9 - FINISHES. Painting and Color Coding.
- B. Division 23 - MECHANICAL.
 - 1. Air Handling Units. Internal insulation for air units is specified in the sections on air handling units. The units do not require external insulation.
 - 2. Internal Duct Liner. Internal duct liner is specified in the section on ductwork.
 - 3. Insulation. Refer to specific sections on individual insulation types.
 - 4. Refer to insulation and liner plan detail.

1.3 QUALITY ASSURANCE

- A. The intent of insulation specifications is to obtain superior quality workmanship, resulting in an installation that is absolutely satisfactory in both function and appearance. Provide insulation in accordance with the specifications for each type of service and apply as recommended by the manufacturer and as specified.
- B. An approved contractor for this work under this Division shall be:
 - 1. A specialist in this field and have the personnel, experience, training, skill, and the 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.
- C. All duct insulation used on the project inside the building must have a flame spread rating not exceeding 25 and a smoke developed rating not exceeding 50 as determined by test procedures ASTM E84, NFPA 255 and UL 723. These ratings must be as tested on the composite of insulation, jacket or facing, and adhesive. Components such as adhesives, mastics and cements must meet the same individual ratings as the minimum requirements and bear the UL label.
- D. Condensation on any insulated system is not approved.
- E. Replace insulation damaged by either moisture or other means. Insulation that has been wet, whether dried or not, is considered damaged. Make repairs where condensation is caused by improper installation of insulation. Also repair any damage caused by the condensation.
- F. Where existing insulated ductwork or other services are tapped, remove existing insulation back to undamaged sections and replace with new insulation of the same type and thickness as existing insulation. Apply as specified for insulation of the same service.

1.4 APPROVALS

- A. Submittals. Submit product data on each insulation type, adhesive, and finish to be used in the work. Make the submittal as specified in Division 1 General Requirements and obtain approval before beginning installation. Include product description, list of materials and thickness for each service and location, and the manufacturer's installation instructions for each product.
- B. Sample Application. Make an application of each type of insulation to display the material, quality and application method. Obtain approval of the sample application before proceeding with installation of the work.

PART 2 – PRODUCTS

2.1 INSULATION

- A. Glass fiber rigid duct insulation.
 - 1. Minimum density of 3 pcf, installed R value to be 6.0 (when located in a conditioned plenum) and 8.0 (when located in an unconditioned plenum) at 75°F mean, facing of 0.7 mil aluminum foil reinforced with glass yarn mesh and laminated to 40 lbs. fire-resistant Kraft. R-value to be indicated on exterior side of insulation to be verified by City inspector.
 - 2. Acceptable Manufacturers
 - a. Schuller 814 spin-glas FSK.
 - b. Owens-Corning Type 703 board RKF.
 - c. Knauf 3 PCF FSK.
- B. Glass fiber blanket duct insulation.
 - 1. Minimum density of 1.0 pcf, installed R value to be 6.0 (when located in a conditioned plenum) and 8.0 (when located in an unconditioned plenum) at 75°F mean, facing of 0.35 mil foil reinforced with glass yarn mesh and laminated to 40 lbs. fire resistant Kraft. R-value to be indicated on exterior side of insulation to be verified by City inspector.
 - 2. Acceptable Manufacturers
 - a. Manville R-series Microlite FSKL.
 - b. Owens-Corning ED100 RKF.
 - c. Knauf 1.0 PCF FSK.
- C. Fiberglass reinforcing cloth mesh.
 - 1. Acceptable Manufacturers
 - a. Perma Glass Mesh.
 - b. Alpha Glass Mesh.
 - c. Childers Chil-Glas #10
 - d. Foster Mast a Fab
 - e. Vimasco.
- D. Mastics, sealants, coatings and adhesives.
 - 1. Acceptable Manufacturers
 - a. Childers.
 - B. Foster.
 - c. Vimasco.
- E. Fireboard Insulation
 - 1. Totally encapsulated with foil facing.
 - 2. Two hour rated fire protection.

3. Zero clearance to combustible protection.
 4. System shall be listed and labeled by an NRTL.
 5. Tested per ISO 6944, Type A Duct and achieve a 2 hour rating for stability, integrity and insulation.
 6. Provided system is subject to the approval of the Local Authority Having Jurisdiction.
 7. Acceptable Manufacturers
 - a. Unifrax ON Fyrewrap Elite 1.5
 - b. Partak Insulation, Inc. Paroc Fireboard
 - c. Thermal Ceramics FireMaster 3M
 - d. Premier Refractories International, Pyroscat.
- F. Rigid Closed Cell Insulation
1. Acceptable Manufacturers
 - a. Dow Trymer.
 - b. Phenolic Foam.
- G. Reinforced Foil Tape
1. Acceptable Manufacturers
 - a. Venture 1525CW
 - b. 3" FSK
 2. Thickness 6.5 mils
 3. Color: silver

2.2 COATING AND ADHESIVE

- A. Coating. Provide Childers CP-38 or Foster 30-80 vapor barrier coating. Coating must meet MIL Spec C-19565C, Type II and be QPL Listed. Permeance shall be 0.013 perms or less at 43 mils dry. Tested at 100°F and 90% RH per ASTM E96.
- B. Outdoors: Provide as insulation coating Childers Encacel X or Foster Monolar 60-90. Permeance shall be 0.03 perms or less at 30 mils dry. Tested at 100°F and 90% RH per ASTM F 1249.
- C. Adhesive. Provide Childers CP-82 or Foster 85-20 vapor barrier adhesive.
- D. Reinforcing Mesh. Provide 10 x 10 white glass or polyester reinforcing mesh.

2.3 OUTDOOR DUCT LAMINATED JACKETING

- A. Rubberized bitumen compound material:
1. Ultraviolet resistant
 2. Weatherproof
 3. Vapor retarding jacketing
 4. Laminated jacketing
 5. Cross-laminated high strength polyethylene film
 6. Laminated to aluminum foil
 7. Minimum 60-mil thickness
- B. Acceptable Manufacturers:
1. Alumaguard 60
 2. Flex Clad 400
 3. Venture Clad 1577CW

PART 3 – EXECUTION

3.1 FIRE SAFETY REQUIREMENTS

- A. Do not extend duct coverings through walls or floors required to be fire-stopped or required to have a fire resistance rating. Interrupt duct coverings in the immediate vicinity of heat sources such as electric resistance or fuel-burning heater.

3.2 CONCEALED DUCT

- A. Provide flexible glass fiber insulation with factory-applied, reinforced UL labeled Foil-Skrim-Kraft (FSK) facing.
- B. Standing Seams. Insulate standing seams and stiffeners, which protrude through the insulation with 0.6 lb. per cubic foot density, 1-1/2" thick, faced, flexible blanket insulation. Insulation shall not prevent adjustment of damper operators.
- C. Insulation shall be wrapped tightly on the ductwork with all circumferential joints butted and longitudinal joints overlapped a minimum of 2". In addition, secure insulation to the bottom of rectangular ductwork by the use of either weld pins with washers or cup-head pins welded to the ductwork or perforated based insulation hangers glued to the duct on twelve inch centers to prevent sagging of insulation.
- D. On circumferential joint, the 2" flange on the facing shall be stapled with 9/16" outward clinch steel staples on 2" centers and taped using 3" wide foil tape applied with additional adhesive of Foster 85-75. Cover all seams, joints, pin penetrations and other breaks with foil tape and glue.
- E. Ductwork in mechanical rooms is considered concealed spaces.

3.3 EXPOSED DUCT INSULATION

- A. Ductwork in exposed locations is to be insulated with fiberglass rigid / semi-rigid board insulation.
 - 1. Apply fabric and mastic to provide a smooth surface for painting.
- B. Standing Seams: Insulate standing seams and stiffeners which protrude through the insulation with 0.6 lb per cubic foot density, 1-1/2 inch thick, faced insulation. As a vapor seal, use reinforcing mesh with vapor barrier coating. Insulation shall not prevent adjustment of damper operators.
- C. Insulation shall be wrapped tightly on the ductwork. Adhere insulation to ductwork with adhesive. In addition, secure insulation to the bottom of rectangular ductwork by the use of either weld pins with washers or cup-head pins welded to the ductwork or perforated based insulation hangers glued to the duct on 12 inch centers to prevent sagging of insulation.
- D. Cover all seams, joints, pin penetrations and other breaks with coating reinforced with reinforcing mesh. Fabric shall not be visible after coating.

3.4 OUTDOOR DUCTWORK COVERING

- A. Cover all supply and return ductwork outdoors:
 - 1. 1-1/2" thick, rigid closed cell insulation with reinforced foil facing.

- B. Install a high point in center and slope in both directions so water will not stand on horizontal surfaces.
- C. Impale the insulation over mechanical fasteners and washers.
 - 1. A minimum of 2 rows of fasteners per side on 12-inch centers.
 - 2. Seal all breaks, joints and punctures by applying a 1/8" thick vapor barrier mastic coating, embedded in open mesh reinforcing mesh.
- D. Standing S, or flanged connections shall be covered with the same thickness of insulation overlapped a minimum of 4".
- E. Apply a tack coat of Childers CP-10/11 or Foster 46-50 weather barrier mastic over the entire surface.
 - 1. While this coat is still tacky, Childers #5 glass fiber reinforcing mesh shall be smoothly applied and pressed into the mastic. The cloth shall be taut with adjacent edges overlapped a minimum of 4".
 - 2. After the first coat of mastic has taken its set, the second coat shall be applied over the cloth by palm, trowel, or spray to sufficient thickness that, when dried, the combined thickness of mastic and cloth is not less than 1/8".
 - 3. Upon completion, the openings in the cloth shall be completely sealed and the yarn shall not be visible. The completed work shall be completely smooth and present a plane surface.
 - 4. Aluminum gray or white finish as approved by the Architect.
- F. Standing water on horizontal surfaces is not approved.
- G. Apply outdoor duct laminated jacketing protection over entire insulation surface. Apply rubberized bitumen compound, applied to a cross-laminated high strength polyethylene film, laminated to aluminum foil.

3.5 KITCHEN GREASE EXHAUST DUCTWORK / KILN DUCTWORK / FUME HOOD DUCT

- A. Secure fireboard insulation to duct with impaling pins and 3" square speed clips. In addition, provide a wire mesh support system and additional sealing or support as required by the code enforcing authority. The insulation support system shall include framed access to allow the insulation to be removed and replaced without damage at the access doors in the duct system for inspection and cleaning. Coordinate location of access openings to correspond accurately. Provide stainless steel banding on 12" centers.

3.6 GENERAL INSTALLATION

- A. Install materials in accordance with manufacturer's instructions.
- B. Apply insulation on clean, dry surfaces only.
- C. Continue insulation with vapor barrier through penetrations.
- D. Neatly finish insulation at supports, protrusions and interruptions.
- E. Install insulation on clean, dry surfaces, and only after building is weatherproofed sufficiently to preclude any rainwater on insulation.
- F. Apply mastic over the fiberglass reinforcing mesh to a thickness where fabric is not visible after completion.

- G. Install fiberglass blanket duct insulation on top of supply air grilles not fire rated.

END OF SECTION

SECTION 23 07 16 - VESSEL INSULATION

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish and install insulation for both high and low temperature vessels.
- B. Low temperature installations include expansion tanks, air eliminators, chiller nozzles, chiller heads and other vessels containing liquids 60°F and below.
- C. High temperature installations include expansion tanks, air eliminators, domestic water storage tanks, boiler stack / transition and other vessels containing liquids above 60°F.

1.2 QUALITY ASSURANCE

- A. The intent of insulation specifications is to obtain superior quality workmanship resulting in an installation that is absolutely satisfactory in both function and appearance. Provide insulation in accordance with the specifications for each type of service and apply as recommended by the manufacturer and as specified.
- B. An approved contractor for this work under this Division shall be:
 - 1. A specialist in this field and have the personnel, experience, training, skill, and the 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.
- C. All vessel insulation used on the project inside the building must have a flame spread rating not exceeding 25 and a smoke developed rating not exceeding 50, as determined by test procedures ASTM E 84, NFPA 255 and UL 723. These ratings must be as tested on the composite of insulation, jacket or facing, and adhesive. Components such as adhesives, mastics and cements must meet the same individual ratings as the minimum requirements and bear the UL label.
- D. Condensation on any insulated vessel system is not acceptable.
- E. Replace insulation damaged by either moisture or other means. Insulation that has been wet, whether dried or not, is considered damaged. Make repairs where condensation is caused by improper installation of insulation, also repair any damage caused by the condensation.
- F. Where existing insulated vessel, or other surfaces are tapped, remove existing insulation back to undamaged sections for hot surfaces or to nearest insulation stop for cold surfaces, and replace with new insulation of the same type and thickness as existing insulation. Apply as specified for insulation of the same service.

1.3 APPROVALS

- A. Submit product data on each insulation type, adhesive, and finish to be used in the work. Make the submittal as specified in Division 1 General Requirements and obtain approval before beginning installation. Include product description, list of materials and thickness for each service and location and the manufacturer's installation instructions for each product.

- B. Make an application of each type of insulation to display the material, quality and application method. Obtain approval of the sample application before proceeding with installation of the work.

1.4 RELATED WORK

- A. Division 9 Finishes. Painting and color-coding

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Glass fiber pipe & tank insulation:
 - 1. Schuller Type 817
 - 2. Owens-Corning Type 705
 - 3. Knauf 2.8 PCF
- B. Closed cell, non-wicking pipe & tank insulation:
 - 1. Armaflex FS, 2" thickness
- C. Aluminum Jacketing:
 - 1. Childers
 - 2. Pabco
 - 3. RPR
- D. Monel Staples
 - 1. Bostich Monel
 - 2. Duo-Fast Monel
 - 3. Markwell Monel
- E. Fiberglass reinforcing cloth mesh:
 - 1. Perma Glass Mesh
 - 2. Alpha Glass Mesh
 - 3. Childers Chil-Glas
 - 4. Foster Mast a Fab
- F. Weather Resistant Coating:
 - 1. WB Armaflex Finish

2.2 CEMENT, MASTICS, SEALANTS, ADHESIVES AND COATINGS

- A. Adhesive: Provide Childers CP-127 or Foster 85-60 fiberglass adhesive to seal insulation for low temperature vessels.
- B. Adhesive / Joint Sealant: Provide Armaflex 520 adhesive to seal insulation for low and temperature vessels.
- C. Lagging Adhesive / Coating: Furnish Childers CP50AHV2 or Foster 30-36 lagging adhesive / coating to provide a finish coat and to secure finish cloth for high temperature vessels.
- D. Insulation Joint Sealant: Use Childers CP-76 or Foster 95-50 to seal the joints of insulation on low temperature vessels.

- E. Metal Jacketing Sealant: Use Childers CP-76 or Foster 95-44 on all metal jacketing laps outdoors.
- F. Vapor Barrier Coating: Indoors - Use Childers CP-38 or Foster 30-80 vapor barrier coating finish to coat the canvas finish on low temperature vessels. Permeance shall be 0.013 perms or less as tested by ASTM E96. Coating must comply with MIL-C-19565C, Type II and be QPL listed. Permeance shall be 0.03 perms or less at 30 mils, dry. Tested at 100°F and 90% RH per ASTM F 1249 and by Hypalon rubber based.
- G. Weather Barrier Mastic: Furnish Childers CP-10/11 or Foster 46-50 weather barrier mastic and reinforcing mesh for outdoor finish.
- H. Reinforcing Mesh: Furnish 10 X 10 white glass or polyester reinforcing mesh.

PART 3 - EXECUTION

3.1 HIGH TEMPERATURE VESSELS (FIBERGLASS)

- A. Apply a first layer of insulating board. Band the board on immediately after application, using bands on 12" centers, drawn tight and securely fastened.
- B. Apply successive layers of insulation as specified for the first layer, with joints staggered. After insulation has been applied, finish with Childers CP-38 or Foster 30-80 vapor barrier coating reinforced with glass or polyester reinforcing mesh per manufacturer's recommendations. Provide a flood coat of Childers CP-10/11 or Foster 46-50 with Foster Mast a Fab polyester or Chil Glas #10 reinforcing mesh.
- C. To insulate removable heads, provide two equal sections of heavy-gauge, galvanized sheet metal covers, angle reinforced and lined with insulation board. Make covers easily removable to allow free access to the heads for inspection, cleaning and dismantling. Provide suitable flanges on the sections with neoprene gaskets between them, permitting a tight seal when the two sections are bolted together. Fill the voids with glass fiber wall cavity insulation.

3.2 LOW TEMPERATURE VESSELS (CLOSED CELL)

- A. Apply a layer of insulating board. Band the insulation on immediately after application, using bands on 12" centers, drawn tight and securely fastened.
- B. To insulate removable heads, provide two equal sections of heavy-gauge, galvanized sheet metal covers, angle reinforced and lined with insulation board. Make covers easily removable to allow free access to the heads for inspection, cleaning and dismantling. Provide suitable flanges on the sections with neoprene gaskets between them, permitting a tight seal when the two sections are bolted together. Fill the voids with closed cell insulation.
- C. Apply weather protective finish on closed cell insulation. Provide a minimum of three coats.

3.3 ALUMINUM JACKETING (Insulated vessels outdoors above grade)

- A. Apply aluminum jacket on vessels according to manufacturer's recommendations using

aluminum strapping and metal jacketing sealant to provide weather tight covering.

- B. Aluminum jacketing is not considered as contributing to the vapor barrier or the insulation jacket. The vapor barrier must be sufficient in itself for this function.
- C. Install straps on 12" centers.

3.4 VESSEL INSULATION REQUIREMENTS

- A. Insulate all low and high temperature vessels located exterior (outside) of the building, including the following:
 - 1. Air separators
 - 2. Expansion Tanks
 - 3. Chemical feeders
 - 4. Chilled water system volume tanks
 - 5. Insulation thickness shall match thickness of adjoining pipe insulation
- B. Insulate all low temperature vessels located interior (inside of the building, including the following):
 - 1. Air separators
 - 2. Chemical feeders
 - 3. Chilled water system volume tanks
 - 4. Insulation thickness shall match thickness of adjoining pipe insulation
- C. Insulate the following high temperature vessels located interior (inside the building).
 - 1. Air Separators
 - 2. Insulation thickness shall match thickness of adjoining pipe insulation
- D. As indicated on the drawings
- E. Expansion tanks, air separators, and volume tanks shall be provided with a access flap or removable section of insulation at vessel nameplate to provide access for inspections.

END OF SECTION

SECTION 23 07 19 - HVAC PIPING INSULATION

PART 1 – GENERAL

1.1 WORK INCLUDED

- A. Furnish and install piping insulation, jackets, accessories and covering of specified materials. The insulation shall be used for high and low temperature piping applications including chilled water, hot water, and condensate piping.

1.2 QUALITY ASSURANCE

- A. The intent of insulation specifications is to obtain superior quality workmanship resulting in an installation that is absolutely satisfactory in both function and appearance. Provide insulation in accordance with the specifications for each type of service and apply as recommended by the manufacturer and as specified.
- B. An approved contractor for this work under this Division shall be:
 - 1. A specialist in this field and have the personnel, experience, training, skill, and the 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.
- C. All piping insulation used on the project inside the building must have a flame spread rating not exceeding 25 and a smoke developed rating not exceeding 50, as determined by test procedures ASTM E 84, NFPA 255 and UL 723. These ratings must be as tested on the composite of insulation, jacket or facing, and adhesive. Components such as adhesives, mastics and cements must meet the same individual ratings as the minimum requirements and bear the UL label.
- D. Condensation on any insulated piping system is not acceptable.
- E. Replace insulation damaged by either moisture or other means. Insulation that has been wet, whether dried or not, is considered damaged. Make repairs where condensation is caused by improper installation of insulation. Also repair any damage caused by the condensation.
- F. Where existing insulated piping, or other surfaces are tapped, remove existing insulation back to undamaged sections for hot surfaces or to nearest insulation stop for cold surfaces, and replace with new insulation of the same type and thickness as existing insulation. Apply as specified for insulation of the same service.

1.3 SUBMITTALS

- A. Submit product data on each insulation type, adhesive, and finish to be used in the work. Make the submittal as specified in General Requirements and obtain approval before beginning installation. Include product description, list of materials and thickness for each service and location and the manufacturer's installation instructions for each product.
- B. Make a field application of each type of insulation to display the material, quality and application method. Obtain approval of the sample application before proceeding with installation of the work.

1.4 RELATED WORK

- A. Finishes. Painting and color-coding

B. Pipe Heat Tracing

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Glass fiber pipe insulation:
 - 1. Johns-Manville Micro-Lok AP-T
 - 2. Owens-Corning ASJ/SSL
 - 3. Knauf ASJ/SSL
- B. Cellular Glass Insulation (Foamglass):
 - 1. Pittsburg Corning
 - 2. Cell-U-Foam
- C. Rigid Foam Insulation:
 - 1. Koolphen - Phenolic Foam
 - 2. Dow Trymer
 - 3. Tarec Ecophen – Phenolic Foam
- D. Aluminum Jacketing:
 - 1. ITW Lock-on (Childers)
 - 2. ITW Z-lock (Pabco)
- E. Fiberglass reinforcing cloth mesh:
 - 1. Perma Glass Mesh
 - 2. Alpha Glass Mesh
 - 3. Childers Chil-Glas
 - 4. Foster Mast a Fab
 - 5. Vimasco
- F. Mastics, Sealants, Coatings and Adhesives
 - 1. Childers
 - 2. Foster
 - 3. Vimasco
 - 4. Armstrong 520 Adhesive
- G. Elastomeric Insulation
 - 1. Armacell
- H. Weather Resistant Coating
 - 1. WB Armaflex Finish
 - 2. Foster 30-64
- I. Glass fiber blanket insulation
 - 1. Manville R-series Microlite FSKL
 - 2. Owens-Corning eD75 or ED100 RKF
 - 3. Knauf 0.75 PCF FSK

2.2 RIGID FOAM PIPE INSULATION

- A. Polyisocyanurate pipe insulation or phenolic foam pipe insulation, with all service reinforced vapor barrier jacket having integral laminated vapor barrier.
 - 1. Polyisocyanurate: Thermal conductivity 0.14 @ 75°F mean (ASTM C518).
 - 2. Phenolic Foam: Thermal conductivity 0.13 @ 75°F mean (ASTM C 518); minimum 2.5# density.
 - 3. Polyisocyanurate is not to be used inside of buildings without 25/50 rating.

2.3 FIBERGLASS PIPE INSULATION

- A. Heavy density, dual temperature fiberglass insulation with factory applied, all service, reinforced vapor barrier jacket having integral laminated vapor barrier. Provide with a factory applied pressure sensitive tape closure system and matching butt strips. Supply in thickness as shown.
1. Thermal conductivity 0.23 @ 75°F mean (ASTM 335).

2.4 ELASTOMERIC INSULATION

- A. Insulation material shall be flexible, closed-cell elastomeric insulation in tubular or sheet form. Material shall have a flame spread rating of 25 or less and a smoke developed rating of 50 or less when tested in accordance with ASTM E84, latest revision. Sheet material with a thickness greater than ¾" shall have a flame spread rating of 25 or less and a smoke developed rating of 100 or less when tested in accordance with ASTM E84, latest revision. In addition, the product, when tested, shall not melt or drip flaming particles, and the flame shall not be progressive. In addition, all materials shall pass simulated end-use fire test.
1. Thermal conductivity 0.27 at 75°F mean (ASTM C177 or C518)

2.5 CELLULAR GLASS INSULATION

- A. ASTM C552:
1. "k" value of 0.35 @ 75°F ("ksi" value of 0.047 @ 24°C);
 2. 8.0 lb/cu.ft. (128 kg/cu.m.) density

2.6 INSULATION/SHIELD AT HANGERS

- A. Field fabricated: Use 360° sections of rigid foamglass insulation that will support the bearing area at hangers and supports. Further support insulation at hangers and supports with a shield of galvanized metal covering at least half of the pipe circumference, and conforming to the schedule. Insulation shall extend at least 1" beyond metal shield on each end. When pipe is guided at top and bottom, metal shields shall cover the whole pipe circumference. Adhere metal shield to insulation so that metal will not slide with respect to insulation with ½" aluminum bands (2) per shield.
1. Sections of foam glass insulation may be used of the same outside diameter of the adjoining pipe insulation.
 2. Minimum thickness of foam glass insulation shall not be less than 1" thick.
- B. Pipe saddles: Formed galvanized sheets at each support point for insulated pipe, shaped to fit pipe, and covering bottom half of pipe. Length at saddle shall be not less than twice the insulation outside diameter or more than 22". Provide 18 gauge through 4" pipe and 16-gauge 5" pipe and above.

2.7 SEALANT, ADHESIVE AND FINISH

- A. Lap Adhesive. Provide Childers CP-82 or Foster 85-20 adhesive.
- B. Vapor Barrier Finish:
1. Indoors: Provide as insulation coating Childers CP-38 or Foster 30-80, white. Coating must meet MIL Spec C-19565C, Type II and be QPL Listed. Permeance shall be 0.013 perms or less at 43 mils dry. Tested at 100°F and 90% RH per ASTM E96.
 2. Outdoors: Provide as insulation coating Childers Encacel X or Foster 60-90. Permeance shall be 0.03 perms or less at 30 mils dry. Tested at 100°F and 90% RH per ASTM F 1249 and must be Hypalon rubber based.

3. Underground: Provide Childers CP-22/24 or Foster 60-25/26 for fittings and areas. Pittwrap cannot be used.
- C. Insulation Joint Sealant. Provide Childers CP-76 or Foster 95-50 vapor barrier sealant.
- D. Metal Jacketing Sealant. Provide Childers CP-76 or Foster 95-44 metal jacketing sealant for all outdoor metal jacketing laps.
- E. Lagging Adhesive. Provide Childers CP-50AMV1 or Foster 30-36.
- F. Other products of equal quality will be acceptable only upon approval.

2.8 ALUMINUM JACKETING

- A. Finish insulated piping outdoors with a smooth prefabricated Z-lock aluminum jacket 0.016" thick with factory applied 1 mil polyethylene/40 lb and Fab strap. Kraft moisture barrier.
- B. Valves, Fittings and Flanges. For finishing valves, fittings, flanges and similar installations, provide formed aluminum covers, 0.024" thick.
- C. Straps and Seals. Provide 1/2" x 0.020 stainless steel strapping and seals for jackets and covers according to manufacturer's recommendations.

2.9 GLASS FIBER BLANKET INSULATION

- A. Minimum density of 1.0 PCF, 2" thick, installed R value to be 6.0 or better at 75°F mean, facing of 0.35 mil foil reinforced with glass yarn mesh and laminated to 40 lbs fire resistant kraft.

PART 3 – EXECUTION

3.1 INTERIOR PIPING

- A. Cover all hot water piping with glass fiber, heavy density, dual temperature pipe insulation with a vapor barrier jacket. Apply insulation to clean, dry pipes. Longitudinal seams shall be joined firmly together and sealed with self-sealing lap joints. Butt insulation joints firmly together and seal with a 3" wide ASJ butt strip seal. Longitudinal seams and butt strip laps shall be coated and sealed with CP-35 vapor barrier coating for chilled water piping applications.
- B. Cover all chilled water piping with rigid foam insulation.
 1. Adhere the vapor barrier jacket longitudinal seam with vapor barrier adhesive.
 2. Cover all valves, fittings and flanges with factory made molded or field fabricated segments of pipe insulation of a thickness and material equal to the adjoining insulation. Adhere segments together with no voids, using CP-82 adhesive. Secure fitting insulation covers and segments in place with 1/2" wide glass filament tape.
 3. Apply a tack coat of fitting mastic over the insulation and tape.
 4. Neatly embed with 10 x 10 fiberglass cloth into the tack coat.
 5. Apply mastic over the fiberglass cloth to a thickness where the fabric is not visible after completion.
 6. Seal ends of pipe insulation with vapor barrier mastic at valves, flanges, fittings and every 21' on straight runs of piping. Mastic should extend on top of ASJ jacket, across the foam, down onto the pipe, making a complete seal.
- C. Install hanger with protective shield, on the outside of all insulation.

- D. Pipe Saddles: Formed galvanized sheets at each support point for insulated pipe, shaped to fit pipe, and covering bottom half of pipe. Length at saddle shall be not less than twice the insulation outside diameter. Provide 18-gauge through 4" pipe and 16-gauge for 5" pipe and above.
- E. Seal ends of pipe for chilled water insulation with vapor barrier mastic at valves, flanges, fittings and every 21' on straight runs of piping. Mastic should extend on top of ASJ jacket, across the glass, down onto the pipe making a complete seal.
- F. Apply a smooth flood coat of white lagging Foster 8142W over all exposed insulation.
- G. Piping to be insulated as specified above:
 - 1. Chilled water and heating water
 - 2. Make-up water

3.2 REFRIGERANT AND CONDENSATE PIPING

- A. Cover all pipe with elastomeric insulation by slitting tubular sections or sliding unslit sections over the open ends of piping or tubing. Seams and butt joints shall be adhered and sealed using Foster 85-75, Childers CP-82 or Armstrong 520 Adhesive.
- B. All fittings shall be insulated with the same insulation thickness as the adjacent piping. All seams and mitered joints shall be adhered with Foster 85-75, Childers CP-82 or 520 Adhesive.
- C. Pipe Saddles: Formed galvanized sheets at each support point for insulated pipe, shaped to fit pipe, and covering bottom half of pipe. Length at saddle shall be not less than twice the insulation outside diameter.
- D. Outdoor exposed piping shall be painted with two coats of either WB or SB Armaflex finish or Foster 30-64 elastomer foam coating. All seams shall be located on the lower half of the pipe.

3.3 PIPING OUTDOORS ABOVE GRADE

- A. Insulate all chilled and hot water piping exterior of building above grade with rigid foam insulation and aluminum jacketing.
- B. Adhere the vapor barrier jacket longitudinal seam with vapor barrier adhesive.
- C. Cover all valves, fittings and flanges with factory made molded or field fabricated segments of pipe insulation of a thickness and material equal to the adjoining insulation. Adhere segments together with no voids, using Childers CP-82 or Foster 85-20 adhesive. Secure fitting insulation covers and segments in place with 1/2" wide glass filament tape.
- D. Apply a tack coat of fitting vapor barrier coating over the insulation and tape.
- E. Neatly embed with 10 x 10 fiberglass or polyester reinforcing mesh into the tack coat.
- F. Apply coating over the fiberglass cloth to a thickness where the mesh is not visible after completion.
- G. Seal ends of pipe insulation with vapor barrier coating at valves, flanges, fittings and every 21' on straight runs of piping. Mastic should extend on top of ASJ jacket, across the foam, down onto the pipe, making a complete seal.

H. Finish with aluminum jacketing as specified.

3.4 FLANGE, VALVE AND FITTING INSULATION

- A. Cover valves and flanges with fabricated segments, fittings with two-piece factory molded fittings, and both of matching pipe insulation type and thickness equal to that of the adjoining pipe. Fittings and fabricated segments shall be securely held in place.
1. Apply a tack coat of insulating coating/mastic to the insulated fitting to produce a smooth surface.
 2. After mastic is dry, apply a second coat of vapor barrier coating/mastic. Neatly embed with 10 x 10 fiberglass or polyester reinforcing mesh into the tack coat.
 3. Overlap coating/mastic and fiberglass/polyester reinforcing mesh by 2" on adjoining sections of pipe insulation.
 4. Apply a second coat of coating/mastic over the fiberglass/polyester reinforcing mesh to present a smooth surface.
 5. Apply coating/mastic to a wet film thickness of 3/64".
 6. Fabric shall not be visible after completion.
 7. Vapor seal flanges, valves and fittings with Childers CP-38 or Foster 30-80. Coating must meet MIL Spec C-19565C, Type II and be QPL Listed. Permeance shall be 0.013 perms or less at 43 mils dry. Tested at 100°F and 90% RH per ASTM E96.
- B. PVC fitting covers are not acceptable.

3.5 MISCELLANEOUS

- A. Insulate chilled water pumps with closed cell insulation box.
- B. Install materials after piping has been tested and approved.
- C. Apply insulation on clean, dry surfaces only.
- D. Apply weather protective finish on elastomeric insulation installed in non-conditioned spaces. Provide a minimum of three coats.

3.6 INSULATION THICKNESS

| <u>INSULATED UNIT</u> | <u>(Inches)</u> |
|---|-----------------|
| Refrigerant Piping | 1-1/2 |
| Chilled Water Piping (through 2" pipe) | 1-1/2 |
| Chilled Water Piping (2-1/2" pipe and Larger) | 2 |
| Condensate Drains | 1 |
| Heating Water Piping 2" Pipe and Larger | 2 |
| Heating Water Piping 1-1/2" Pipe and Smaller | 1-1/2 |
| Exterior Chilled and Hot Water Piping, 5" Pipe and Larger | 2 |
| Exterior Chilled and Hot Water Piping 4" Pipe and Smaller | 1-1/2 |

END OF SECTION

SECTION 23 08 00 - HVAC SYSTEMS TECHNICAL COMMISSIONING REQUIREMENTS

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. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.2 SUMMARY

- A. The purpose of this Section is to define responsibilities in the Commissioning Process. Additional system testing is required within individual Specification Sections.
- B. Commissioning requires the participation of the Contractor to ensure that all systems are operating in a manner consistent with the Contract Documents. General Commissioning requirements and coordination are detailed in Division 01. Division 20-25 Contractors shall be familiar with all parts of Division 01 and the Commissioning Plan issued by the Owner's CxA, shall execute all Commissioning responsibilities assigned to them in the Contract Documents and include the cost of Commissioning in the Contract price.
- C. HVAC systems to be commissioned include the following:
 - 1. Chillers
 - 2. Boilers
 - 3. Pumps
 - 4. Air Handling Unit Systems
 - 5. DX Split Systems
 - 6. Air Terminal Units (10% Sampling)
 - 7. Fan Coil Units
 - 8. Exhaust and Supply Fan Systems
 - 9. Fire, Fire/Smoke and Volume Dampers (Review of testing documentation provided by the contractor)
 - 10. HVAC / Building Automation System and Integrations
 - 12. HVAC / Emergency Power Source Integrations
 - 13. HVAC / Life Safety Systems Integrations
- D. The TAB Contractor will perform control sequence verification on each terminal unit shall independently verify each sensor and point and document the results to be included in the Final TAB Report. The CxA will commission 10% of the terminal units once TAB is complete with the CSV and point verification of the terminal units.

1.3 DEFINITIONS

- A. Refer to the General Commissioning Requirements for definitions.

1.4 SUBMITTALS

- A. Contractor shall provide Owner and/or CxA with documentation required for Commissioning Work. At minimum, documentation shall include: Detailed Start-up procedures, full sequences of operation, Operating and Maintenance data, performance data, control drawings, and details of Owner-contracted tests.

1. Shop drawings and product submittal data related to systems or equipment to be commissioned.
- B. Contractor shall submit to Owner and/or CxA installation and checkout materials actually shipped inside equipment and actual field checkout sheet forms used by factory or field technicians.
- C. Where installation testing may be performed in a progressive manner (i.e., piping hydrostatic testing, ductwork pressure testing, etc.), the Contractor shall prepare and submit to the Owner, A/E team and CxA a testing plan that details how the progressive testing will be performed, documented and presented for approval prior to the start of any testing activities.
- D. Contractor shall provide any additional documentation needed to complete the requirements of the Commissioning Process
 1. Factory Performance Test Reports: Review and compile all factory performance data to assure that the data is complete prior to executing the FPTs.
 2. Installation testing reports such as ductwork pressure testing, piping hydrostatic testing, piping chemical treatment and flushing, bolt flange torquing, and any documentation associated with local code authority inspections or authorizations.
 3. Completed equipment Start-up certification forms along with the manufacturer's field or factory performance and Start-up test documentation.
 4. Operating and Maintenance (O&M) information per requirements of the Technical Specifications and Division 01 requirements.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All materials and installation shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.
- B. Refer to the General Commissioning Requirements for other work products related to the Commissioning Process
- C. Contractor is required to follow all applicable industry and site specific safety practices, lockout / tagout requirements, specialized PPE requirements, and provide qualified, trained personnel to execute Commissioning Process requirements.

2.2 TEST EQUIPMENT

- A. Contractor shall provide all specialized tools, test equipment and instruments required to execute Start-up, checkout, and testing of equipment.
- B. All specialized tools, test equipment, and instruments required to execute Start-up, checkout, and testing of equipment shall be of sufficient quality and accuracy to test and/or measure system performance within specified tolerances. A testing laboratory must have calibrated test equipment within the previous twelve (12) months. Calibration shall be NIST traceable. Contractor must calibrate test equipment and instruments according to manufacturer's recommended intervals and whenever the test equipment is dropped or damaged. Calibration tags must be affixed to the test equipment or certificates readily available.

PART 3- EXECUTION

3.1 CONSTRUCTION PHASE

- A. In each purchase order or subcontract that is written for changes in scope, include the appropriate requirements for submittal data, Commissioning documentation, testing assistance, Operating and Maintenance (O&M) data, and training, as a minimum.
- B. Attend Pre-Commissioning Meeting(s), Pre-Installation Meeting(s), and other Project meetings scheduled by the Owner, CxA or Contractor to facilitate the Commissioning process.
- C. Provide manufacturer's data sheets and shop drawing submittals of equipment.
- D. Provide additional requested documentation to the Owner and/or CxA, prior to O&M manual submittals, for development of System Verification Checklists and Functional Performance Testing procedures.
 - 1. Typically, this will include detailed manufacturer's installation and Start-up, operating, troubleshooting and maintenance procedures, full details of any Owner-contracted tests, full factory testing reports, if any, and full warranty information.
 - 2. In addition, the installation, Start-up, and checkout materials that are actually shipped inside the equipment and the actual field checkout sheet forms to be used by the factory or field technicians shall be submitted to the Contractor and/or CxA.
 - 3. This information and data request may be made prior to normal submittals.
- E. With input from the BAS vendor and A/E, clarify the operation and control of commissioned equipment in areas where the Specifications, BAS control drawings, or equipment documentation are not sufficient for writing detailed test procedures.
- F. During the installation, Start-up and initial checkout process, execute and document related portions of the System Verification Checklists for all commissioned equipment according to the procedures indicated in the Commissioning Plan.
- G. Factory Start-ups: Factory Start-ups are specified for certain equipment. Factory Start-ups generally are Start-up related activities that will be reviewed and checked prior to Functional Performance Tests. All costs associated with factory Start-ups shall be included with the contract price unless otherwise noted. Notify the Commissioning Team of the factory Start-up schedule and coordinate these factory Start-ups with witnessing parties. The Commissioning Team members may witness these Start-ups at their discretion.
- H. Independent Testing Agencies: For systems that specify testing by an independent testing agency, the cost of the test shall be included in the Contract price unless otherwise noted. Testing performed by independent agencies may cover aspects required in the System Verification Checklists, Start-ups, and Functional Performance Tests. Coordinate with the independent testing agency so that CxA, Owner and/or A/E can witness the test to ensure that applicable aspects of the test meet requirements.
- I. Incorporate manufacturer's Start-up procedures with System Verification Checklists (SVC).
- J. Air and water test, adjust and balance shall be completed with discrepancies and problems remedied before Functional Performance Tests of the respective air or water related systems are executed.

- K. Provide skilled technicians to execute starting of equipment and to assist in execution of Functional Performance Tests. Ensure that they are available and present during the agreed-upon schedules and for a sufficient duration to complete the necessary tests, adjustments, and problem solving.
- L. Correct deficiencies (differences between specified and observed performance) as interpreted by the Owner's Project Manager and A/E and retest the system and equipment.
- M. During construction, maintain as-built marked-up Drawings and Specifications of all Contract Documents and Contractor-generated coordination Drawings. Update after completion of Commissioning activities (include deferred tests).
- N. Provide training of the Owner's operating personnel as specified.
- O. Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.

3.2 WARRANTY PHASE

- A. Execute seasonal or deferred tests, witnessed by the CxA and Owner, according to the Specifications.
 - 1. Complete deferred tests as part of this Contract during the Warranty Period. Schedule this activity with the Owner.
- B. Correct deficiencies and make necessary adjustments to O&M manuals, Commissioning documentation, and as-built drawings for applicable issues identified in any deferred or seasonal testing.

3.3 INSTALLATION

- A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.
- B. All installation shall be in accordance with the Project Documents.

3.4 TRAINING

- A. Refer to the individual section of this Specification for specific training requirements on each system.
- B. Refer to the General Commissioning Requirements and Division 01 for overall training requirements related to the Commissioning process and this project.

END OF SECTION

SECTION 23 09 33 - BUILDING MANAGEMENT AND CONTROL SYSTEM

PART 1 – GENERAL

1.1 SCOPE

- A. The existing campus is controlled by an Automated Logic Control system installed by ALC Houston. All new equipment and modifications to existing systems shall be fully integrated into the existing control system including new graphics for all new equipment and is a part of this scope. Upon completion of this projects the resulting control system shall have all new controllers for the systems being replaced or added including sensors, valves, dampers, valve and damper operators, DDC panels, relays, terminal equipment controllers, mounting brackets and thermowell, etc. Integrate all components to provide a complete and functioning system.
- B. Temperature Control System components:
 - 1. Electronic instruments as specified
 - 2. Electric instruments as specified
 - 3. Microcomputer instruments as specified
- C. All control devices of the same type product shall be of a single manufacturer.
- D. Control, power and interlock wiring necessary to accomplish sequences specified in this Section shall be provided and installed by the Control Subcontractor. Materials and methods of execution as specified in Division 26, Electrical.
 - 1. Coordinate current characteristics of all electrical instruments and equipment with Division 26 of the specifications and related electrical drawings.
- E. The entire Building Management and Control System (BMCS) shall be installed, Commissioned, and tested; all performed by the Automation System Manufacturer or Authorized Distributor if approved by engineer.
 - 1. All components and elements.
 - 2. Start-up and point verification.
 - 3. The testing and acceptance procedure.
- F. The manufacturer of the building automation system shall provide documentation supporting compliance with ISO-9002 (Model for Quality Assurance in Production, Installation, and Servicing). The intent of this specification requirement is to ensure that the products from the manufacturer are delivered through a Quality System and Framework that will assure consistency in the products delivered for this project.
- G. **The cost of the work specified in this section is included in an allowance.**
 - 1. **Selection of subcontractor will be determined at a future date.**

1.2 RELATED WORK

- A. Division 23, Mechanical
- B. Division 26, Electrical

1.3 SUBMITTALS

- A. Submit items of the Building Management and Control System (BMCS).
 - 1. Temperature control equipment & Field devices.
 - 2. Wiring & Flow diagrams.

3. Sequence of operation.
4. Complete, detailed, control and interlock-wiring diagram.
5. Indicate mechanical and electrical equipment furnished and electrical interlocks, indicating terminal designation of equipment. Respective equipment manufacturers shall furnish through the Mechanical Contractor, approved drawings of equipment to be incorporated in this diagram.
6. Submit Input / Output summary of all points.
7. Submit an outline of testing procedures from section Testing and Acceptance.
8. Mark up a copy of the specifications for the product. Indicate in the margin of each paragraph the following: "Comply", "Do Not Comply", or "Not Applicable". Explain all "Do Not Comply" statements.
9. Submit sample of space temperature sensor and guards for review prior to purchase or installation.

1.4 COOPERATION WITH OTHER TRADES

- A. Furnish control valves, temperature sensing element wells, flow and pressure sensing devices, dampers and other similar devices to the Mechanical Contractor in a timely manner for installation under the Building Management and Control System (BMCS), Subcontractor's supervision.

1.5 METERING AND VERIFICATION REQUIREMENTS

- A. This project is a CHPS applicant. Granular data, derived from the BAS and inherent to this specification, is to be handled in such a way as to support this certification. Granular data is defined as temperatures, set points, run times and utility monitoring. This data is to be monitored on a fifteen-minute interval basis and stored in the BAS database. The BAS must have the inherent capability to trend and display all information as described below.
- B. Monitoring software must include outside environmental condition data which affect building performance. Heating degree days and cooling degree days must be logged and formatted in such a way that the data may be used for comparative analysis of multiple facilities, this facility and any CyFair ISD facility on a historical basis over time. This data must be imported from a reliable, certified, third party source. On site instrumentation is not acceptable.
- C. Metering and Verification requirements must be inherent to the BAS. It cannot be a "bolt on" product. It shall be of no extra cost to the project. It shall be easily accessible from the graphical interface on the main screens. It shall also be accessible from the BAS navigation tree. Data must be retrieved and stored in the BAS module until it is archived on the BAS server. Data acquisition and storage must continue even if communication to the facility is lost. Data for utility consumption and environmental indexing must be stored on the server for a minimum of two years.
- D. All data described in this section shall be easily extractable, without external software or programming.

1.6 WARRANTY

- A. Provide with a manufacturer's parts and labor warranty for a period of two years from substantial completion. Warranty shall include unlimited telephone technical support during the warranty period.
- B. Provide DDC controllers with a manufacturer's parts and labor warranty for a period of 5

years from substantial completion.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Automated Logic Branch Office – WebCTRL

2.2 SYSTEM ARCHITECTURE

- A. The Building Management and Control System (BMCS) shall consist of an information-sharing network of stand-alone Direct Digital Control Panels (DDCP) to monitor and control equipment as specified of the control sequence and input/output summary.
- B. "Information sharing" shall be defined as: The function of each DDCP to exchange data on the network trunk with other DDCP's without the need for additional devices such as network managers, gateways or central computers.
- C. "Stand-alone" shall be defined as: The function of each DDCP to independently monitor and control connected equipment through its own microcomputer.

2.3 COMMUNICATIONS PROCESSING

- A. The BMCS shall operate as a true token-pass peer-to-peer communication network. Resident processors in each DDCP shall provide for full exchange of system data between other DDCP's on the network trunk. Systems that limit data exchange to a defined number of system points are not acceptable.
- B. Systems that operate via polled response or other types of protocols that rely on a central processor or similar device to manage DDCP to DDCP communications may be considered only if a similar device is provided as a stand-by. Upon a failure of malfunction of the primary device, the stand-by shall automatically, without any operator intervention, assume all BMCS network management activities.
- C. The failure of any DDCP on the network shall not affect the operation of other DDCP's. All DDCP failure shall be annunciated at the specified alarm printers and terminals.
- D. Network shall support a minimum communications speed of 115.2 Kbps.
- E. The network shall support a minimum of 100 DDC controllers and PC workstations.
- F. Each PC workstation shall support a minimum of 4 peer-to-peer networks, either by hardwired connection or dial up.
- G. The system shall support integration of third party systems (fire alarm, security, lighting, PCL, chiller, boiler) via panel mounted open protocol processor. This processor shall exchange data between the two systems for inter-process control. All exchange points shall have full system functionality as specified herein for hardwired points. Provide examples of 5 reference projects utilizing gateways required for this project.

2.4 DDCP HARDWARE

- A. Each DDCP shall consist of a 32-bit microprocessor and controller, power supply, input / output boards and communication board. All program and point databases shall be stored in battery-backed RAM. Provide a minimum of 1.2 MEG RAM in each DDCP to allow for point expansion and trend data storage.

- B. Each DDCP shall incorporate a real-time clock.
- C. Each DDCP shall be provided with two RS232 communications port. Connecting an operator terminal, whether portable or stationery, shall allow the user to communicate with the entire network.
- D. Each DDCP shall provide for input / output connections to field equipment. The following point types shall be supported:
 - 1. Analog inputs - for measuring sensed variables. Inputs shall be capable of accepting voltage, resistance, current or pressure signals.
 - 2. Analog outputs - for controlling end devices. Outputs shall be capable of producing voltage, resistance, current or pressure signals. Pneumatic outputs shall be provided with a manual override for adjusting outputs in the event of a power loss at the DDCP.
 - 3. Digital inputs - for monitoring dry contacts such as relays, switches, pulses, etc.
 - 4. Digital outputs - to control two position devices such as starters, actuators, relays, etc.
- E. Each DDCP shall be listed under UL916 (Energy Management Systems), and shall be tested to comply with sub-part J of Part 15 FCC rules for Class A computing equipment.
- F. Each DDC Controller shall have sufficient memory to support its own operating system and databases, including:
 - 1. Control processes
 - 2. Energy management applications
 - 3. Alarm management applications including custom alarm messages for each level alarm for each point in the system.
 - 4. Historical/trend data for points specified
 - 5. Maintenance support applications
 - 6. Custom processes
 - 7. Operator I/O
 - 8. Dial-up communications
 - 9. Manual override monitoring
- G. Operator shall have the ability to manually override automatic or centrally executed commands at the DDC Controller via local, point discrete, on-board hand/off/auto operator override switches for digital control type points and gradual switches for analog control type points.
 - 1. Switches shall be mounted either within the DDC Controllers key-accessed enclosure, or externally mounted with each switch keyed to prevent unauthorized overrides.
 - 2. DDC Controllers shall monitor the status of all overrides and inform the operator that automatic control has been inhibited. DDC Controllers shall also collect override activity information for reports.
 - 3. **All BMCS control modules shall have Hand Off Auto (HOA) switches on all outputs for HVAC and electrical, including digital outputs.**
- H. DDC Controllers shall provide local LED status indication for each digital input and output for constant, up-to-date verification of all point conditions without the need for an operator I/O device. Graduated intensity LEDs or analog indication of value shall also be provided for each analog output. Status indication shall be visible without opening the panel door.
- I. In the event of the loss of normal power, there shall be an orderly shutdown of all DDC Controllers to prevent the loss of database or operating system software. Non-volatile

memory shall be incorporated for all critical controller configuration data and battery backup shall be provided to support the real-time clock and all volatile memory for a minimum of 72 hours.

1. Upon restoration of normal power, the DDC Controller shall automatically resume full operation without manual intervention.
2. Should DDC Controller memory be lost for any reason, the user shall have the capability of reloading the DDC Controller via the local RS-232C port, via telephone line dial-in or from a network workstation PC.
3. Upon restoration of normal power, the DDC Controller shall automatically resume full operation without manual intervention.

2.5 PROGRAMMING FUNCTIONS

- A. Resident software in each DDCP shall provide custom programming of control strategies.
 1. Point database
 2. Operator interface
 3. Network communications
 4. Facilities and energy management functions
- B. Programming of control and energy management strategies shall be accomplished via a high-level computer language such as BASIC, JC BASIC, C, or Powers Process Control Language. A standard math processor shall be part of the programming language. All analog loops shall be capable of proportional, integral and derivative control.
- C. Each DDCP shall incorporate an operator interface program (OIP) that provides an English language user interface. The OIP shall allow the user to program, interrogate, command and edit the BMCS via a self-prompting method. Operator terminals, whether textual or graphical, shall be able to access the entire network from any DDCP. Access shall be accomplished in a transparent fashion; that is, the operator shall not be required to address specific DDCP's in order to display or command system points.

2.6 FACILITY MANAGEMENT SOFTWARE

- A. The BMCS shall be provided with standard and custom report generation functions that include:
 1. Alarm summaries
 2. Motor status summaries
 3. Point displays by type, system, status, overrides, failures, location, equipment and enabled/disabled.
 4. Program listings
- B. All reports shall be either displayed or printed by:
 1. Operator request.
 2. Time of day.
 3. Event conditions (such as in response to an alarm, interlock, etc.).
- C. All reports shall be time and date stamped.
- D. An alarm-processing program shall be provided to annunciate those points designated as alarmable. Alarm points shall, upon alarm occurrence, be displayed or printed at designated terminals.
- E. Historical trend data shall be collected and stored at each DDCP for later retrieval. Retrieval shall be manual or automatic. Any point, physical or calculated, may be designated for trending. The system shall allow for two methods of trend collection: Either by a pre-defined time interval sample or upon a pre-defined change of value. Trend data

shall be presented in a columnar format. Each sample shall be timed stamped. Trend reports may be a single point or may be a group of points, up to a maximum of (8) points in any single group. Any point, regardless of physical location in the system may become part of a multiple point group.

- F. Each BMCS network shall provide a point-monitoring function that can display single or multiple points in a continuous updated fashion for dynamic displays of point values.
- G. A database and configuration report program shall be provided that allows the user to interrogate BMCS status. As a minimum, the user shall be able to: Verify available RAM at each DDCP, verify DDCP status (on-line, off-line, and failed) and set the system clock.
- H. Any invalid operator entry shall result in an error message.
- I. DDCP's shall contain a password access routine that will assign an operator to one of three level of access. Level 1 shall permit display function only, level 2 shall additionally permit commanding of system points and level 3 shall additionally permit full program and database editing.
- J. DDCP's shall provide for the accumulation of totalized values for the purposes of run-time or energy totalization. Totalized values may be displayed or printed automatically or by operator request.

2.7 ENERGY MANAGEMENT SOFTWARE

- A. The BMCS shall be provided with an optimal start program such that the building may be divided into ten zones for optimum start. Warm-up and cool-down shall occur in sequence with succeeding zones starting only after the preceding zone has completed its warm-up or cool-down.
 - 1. The optimum start-up time of assigned equipment shall be determined based on a software calculation that takes into consideration outdoor air conditions, space conditions, and building thermal characteristics ("U" factor).
 - 2. The optimum start program shall control start-up of the cooling and heating equipment to achieve the target occupancy space temperature at the precise time of building occupancy.
 - 3. A built-in "learning" technique shall cause the BMCS to automatically adjust itself to the most affective time to start equipment based on historical data.
- B. The BMCS shall be provided with an operator interactive time of day (TOD) program. TOD programming and modifying shall be accomplished in a calendar-like format that prompts the user in English language to specify month, year, day and time and associated point commands. It shall be possible to assign single points or groups of points to any on or off time. Appropriate time delays shall be provided to "stagger" on times.
 - 1. TOD shall incorporate a holiday and special day schedule capability, which will automatically bring up a pre-defined holiday or special day schedule of operation. Holidays or special days can be scheduled up to one year in advance.
 - 2. In addition to the time dependent two-state control, TOD also provides time dependent setpoint control. This control provides the capability to output assignable, proportional setpoint values in accordance with the time of day and day of week. This program shall be used to accomplish night setback, morning warm-up and normal daily operating setpoints of all control system loops controlled by the BMCS. As with the two-state control, time dependent setpoint control shall be subject to the holiday schedule. The setpoints desired shall be user definable at any operator terminal.

3. The operator shall be capable of reading and/or altering all sorted data pertaining to time of day, day of week, on/off times, setpoint values, and holiday designation.
 4. The TOD program shall also provide an override function that allows the user to conveniently change a start or stop time for any point up to one week in advance. The override command shall be temporary. Once executed the TOD program shall revert to its original schedule.
 5. The TOD program shall interface with the optimal start program (OSP) such that stop times may be assigned by OSP.
- C. Additional Program functions required are to be installed and programmed as requested by end user at no additional cost:
1. Enthalpy optimization.
 2. Supply air reset.
 3. Hot water reset.
 4. Chilled water reset.
 5. Volumetric control.
 6. Dead band control. Install dual set points as requested by user.
 7. All specified energy management programs, whether or not applicable to this project shall be provided such that the owner may enable the program at a future date without the need to purchase additional software or modify existing software.
 8. Time lapse graphics
 9. Global point commands
- 2.8 WEB SERVER ACCESSIBILITY
- A. Industry leading encryption technology to provide accessibility through a web browser.
 - B. Building Manager's ability to access, view and command critical building information in real time over the intranet or internet.
 1. Alarm Display
 2. Point Commanding
 3. Graphic Display
 4. Scheduling
 5. Running Reports
 6. Point Details
- 2.9 REMOTE NOTIFICATION
- A. Remote notification sends Alarm and System Event information to various notification devices as indicated below but not limited to. Operators can receive their building automation system alarms without restricting them to dedicated workstations.
 1. Alphanumeric pagers
 2. Numeric pagers
 3. Email
 4. Phones via voice or short message service (SMS) Text Messaging
- 2.10 POINT EXPANSION MODULES
- A. Capable of extending its input/output capabilities via special purpose modules.
 1. Modules may be mounted remote from the DDCP.
 2. Shall communicate with the DDCP over a pair of twisted cables.
 3. Operator shall have the ability to manually override automatic or centrally executed commands at the DDC Controller via local, point discrete, on-board hand/off/auto operator override switches for digital control type points and gradual switches for

- analog control type points.
4. All BMCS control modules shall have Hand Off Auto (HOA) switches on all outputs for HVAC and electrical, including digital outputs.

2.11 TERMINAL EQUIPMENT CONTROLLERS

- A. Provide for control of each piece of equipment, including, but not limited to, the following:
 1. Variable Air Volume (VAV) boxes
 2. Constant Air Volume (CAV) boxes
 3. Dual Duct Terminal Boxes
 4. Unit Conditioners
 5. Variable Refrigerant Volume DX System
 6. 100% Outside Air Split System
 7. Room Pressurization
 8. Fan Coil Units
- B. Include the following items:
 1. All input and outputs necessary to perform the specified control sequences.
 - a. Analog outputs shall be industry standard signals such as 24V floating control.
 2. Sufficient memory to accommodate point database, operating programs, local alarming and local trending.
 3. All databases and programs shall be stored in non-volatile EEPROM, EPROM and PROM, or minimum of 100-hour battery backup shall be provided.
 4. Return to full normal operation without user intervention after a power outage of unlimited duration.
 5. Operation programs shall be field selectable for specific applications.
 6. Specific control strategy requirements, allowing for additional system flexibility.
 7. Controllers that require factory changes of all applications are not acceptable.

2.12 ELECTRONIC DAMPER ACTUATORS

- A. Two position damper operators:
 1. Spring return to full travel position.
 2. Built in auxiliary switches (motor end switches)
 - a. Switch shall be fully adjustable so that cut-in/cut-out points may be preset at any point within angular travel of the motor.
 3. Minimum torque 60-in-lb
- B. Modulating damper operators:
 1. Sized with sufficient reserve power to provide smooth modulating action and tight close off against the system pressure
 2. Select the operator with available torque to exceed the maximum required operating torque by not less than 50%
 3. Minimum torque 100 in-lb

2.13 ETHERNET CARD

- A. Ethernet Card:
 1. Local area network connection interface card.

2.14 CONTROL CABINETS

- A. Fully enclosed NEMA 1 for indoors, NEMA 4 for outdoors.
 1. Powder coat painted on all sides

2. Cabinet with continuously piano type hinged door
3. Locking latch
4. All locks shall use a common key
5. Devices on the panel face must be identified with engraved nameplates.
6. Panels or termination panels must be identified with engraved nameplates.
7. Provide enamel beige finish and extruded aluminum alloy frame UL 50 certified.

2.15 REFRIGERANT MONITOR

- A. Infrared Halogen Gas monitoring system for low level continuous monitoring of numerous CFC, HFC and HCFC halogen gases used in most refrigeration and air conditioning systems.
- B. Two years parts and labor warranty.
- C. Analyzer:
 1. Microprocessor based
 2. Infrared (IR) sensor technology
 3. Sensing down to 1 (PPM)
 4. Monitor multiple compounds
 5. Automatic calibration
 6. Synchronous 2 wave length infrared filterometer
 7. Insensitive to vibration and temperature variations.
 8. Response Time: Min.5 sec / Max. 90 sec.
 9. Sampling Mode in Auto and Manual operation
- D. Multi-Point Sampling System:
 1. Minimum of six sample points
 2. Adjustable sampling time, with optional skip and hold features for each point.
 3. Sample lines up to 500' in length
 4. Three stage alarms for each point
 5. Flow loss and malfunction indicators
 6. Individual relay contacts for each set of channel alarms.
 7. Infrared detection
- E. Alarming and Display:
 1. Digital display in PPM/PERCENTAGE
 2. Provide a 0-10V and 4-20mA output for direct input into the Building Management System or Direct Digital Control System.
 3. Adjustable three level alarm for each point shall and be supplied with common alarm output contacts.
 4. Provide local digital indication of PPM level for each sample point.
 5. Loss of any sample flow
 6. Identify alarm point by flashing display and actual PPM.
 7. Automatic zero mechanism and malfunction indicators.
 8. Silence audible alarm switch with re-activation after adjustable time delay.
- F. Power requirement:
 1. 120 VAC
- G. Audible sound pressure level of at least 15DbA above the operating ambient noise level within machine room and providing a distinctive strobe type visual alarm both inside and out side machine room at each entrance. Ceiling mounted rotating beacon in center of machine room. Strobes shall be provided immediately adjacent to and outside of each refrigeration machinery room exit. A clearly identified switch of the break-glass type shall

be provided immediately adjacent to and outside of each refrigeration machinery room exit.

- H. Acceptable manufacturers:
1. General Analysis Corporation
 2. Yokogawa Corporation
 3. MSA
 4. Sherlock
 5. Vulcain

2.17 AUTOMATIC CONTROL VALVES

- A. Pressure ratings: Minimum 125 psig or 1.25 times maximum system operating pressure.
- B. Construction:
1. 2" and smaller:
 - a. Screwed.
 - b. Bodies and internal parts: Bronze, stainless steel or other approved corrosion-resistant metal.
 2. 2-1/2" and larger:
 - a. Flanged.
 - b. Bodies: Cast iron or cast steel.
 - c. Seats and parts exposed to fluid: Bronze, stainless steel or other approved corrosion-resistant metal.
 3. Characterized port ball valves are acceptable for VAV terminal units only.
- C. Modulating straight through water valves: Equal percentage contoured throttling plugs.
- D. Three Way Mixing Valves: Linear throttling plugs allowing total flow through valve to remain constant regardless of position.
- E. Sizes: By Automatic Control System Manufacturer for fully modulating operation.
1. Minimum pressure drop: Equal to pressure drop of coil or exchanger.
 2. Maximum pressure drop: 5.5 psi.
 3. Relief and bypass valves: Sized according to pressure available.
 4. 2-position valves: Line size.
 5. Manual by-pass operator.
- F. Electronic Actuator:
1. Direct coupled installation
 2. Visual and electronic stroke indicator
 3. Die-cast aluminum housing
 4. Manual override
 5. Self-lubricating bearing and gear train
 6. Automatic calibration
 7. Automatic duty cycle protection
 8. Overload and stall protection
 9. Non-spring return
 10. Floating /0-10 VAC / 4-20mA operation
 11. UL approved
 12. Provide smooth modulating action and tight close off against the system pressure.
 13. Torque to exceed the maximum required operating torque by not less than 50%.
 14. Actuator input signal shall be compatible with output DDC controller.
 15. Provide weatherproof enclosure (exterior use).

16. Damper actuators not acceptable for valves.
- G. Cooling Tower By-Pass and Chiller / Cooling Tower Isolation Valves & Actuators:
 1. Valve Bray (Series 3L or NYL)
 - a. Line Size Valve
 - b. Under-cut disk for smooth operation
 - c. Full Lug Valve
 - d. Cast Iron Body
 - e. EPDM - Seat
 - f. 416 Stainless Steel Stem
 - g. Nylon Coated Ductile Iron Disc
 - h. Disc-to-stem connection shall utilize a double "D" or key design requiring no screws or pins to connect stem to disc.
 2. Electronic Actuator: Bray (Series 70)
 - a. Fully configurable without need for software or handheld settings device
 - b. Direct Mount
 - c. Solid state speed control
 - d. Visual and electronic stroke indicator.
 - e. Anti-Condensation Heater (exterior actuators)
 - f. Die-cast aluminum housing.
 - g. Manual override by means of hand wheel
 - h. Self-lubricating bearing and gear train.
 - i. All steel self-locking output gearing to be provided
 - j. Continuous Duty Rated Motor
 - k. Overload and stall protection.
 - l. Floating /0-10 VAC / 4-20mA operation.
 - m. Mechanical Travel stops
 - n. UL approved.
 - o. Smooth modulating action.
 - p. Tight close off against the system pressure.
 - q. Sized to exceed 150% of the maximum required operating torque of the valve while under the maximum rated shut-off pressure
 - r. Actuator input signal shall be compatible with output DDC controller.
 - s. Provide weatherproof enclosure
 - t. Damper actuators not acceptable for valves.
- H. Variable Primary Flow By-Pass Control Valve:
 1. Modulating straight through control valve with equal percentage contoured throttling plug and electronic operator.
 2. Maximum pressure drop: 10 psi
 3. Sized for minimum flow of one chiller
 4. Torque to exceed the maximum required operating torque by not less than 150%.

2.18 DIFFERENTIAL PRESSURE SWITCHES

- A. Wet/wet differential pressure switch
 1. Integral Mounting Frame
 2. Watertight, dust-tight, and corrosion resistant enclosure.
 3. Wetted materials of brass and flouroelastomer.
 4. Externally adjustable set point
- B. Approved manufacturer:
 1. Square D #9012GGW4
 2. Dwyer #DXW-11-153-1
 3. Carrier #HK06ZC033

2.19 TEMPERATURE LOW LIMIT SWITCH

- A. Responsive to the coldest 1' section of its length.
 - 1. Double pole single throw switch
 - 2. 20' capillary
 - 3. Line voltage with bellows actuated switch
 - 4. Auto reset for outdoor installation
 - 5. Manual reset for indoor installation

2.20 TEMPERATURE AND HUMIDITY SENSORS

- A. Space Temperature Sensors
 - 1. Thermistor with resistance of 10,000 ohms at 77°F.
 - 2. Accuracy shall be +/-1/2°F.
 - 3. Range of 45° to 95° F operating range.
 - 4. Provide manufacturers calibration certificate.
 - 5. Flush Mounted
 - a. Stainless steel flush mount sensor, submit sample for review.
 - 6. Location and height to be approved by Architect/Engineer prior to installation.
- B. Space / Duct Humidity Sensor
 - 1. Capacitance element in the space or duct as required and output a 4 to 20 MA signal proportional to 0 to 100% RH to the DDC.
 - 2. Capacitance element shall be field replaceable and not require calibration.
 - 3. Accuracy shall be +/-2% in the range from 20 to 95% RH.
 - 4. Relative humidity sensors shall have the sensing element of inorganic resistance media.
 - 5. Provide locking metal covers suitable for institutional use. Submit sample for review.
 - 6. Provide manufacturers calibration certificate.
 - 7. Provide metal guards in the following locations:
 - a. Corridors
 - b. Cafeteria
 - c. Kitchen.
 - d. Gymnasium.
 - e. Dressing Rooms.
 - f. Industrial Labs.
- C. Duct Temperature Sensors
 - 1. Range of 20° to 120°F.
 - 2. Single point sensing of temperature.
 - 3. Averaging elements of sufficient length to sense temperature across 2/3 duct width.
 - 4. Averaging elements of sufficient length to provide accurate, representative indication and control.
 - 5. Averaging elements of sufficient length to prevent variances in temperature or stratification.
- D. Liquid Immersion Temperature Sensors
 - 1. Platinum type resistance temperature detector (RTD).
 - 2. Match sensor range to medium being monitored.
 - a. Hot water range 30° to 250°F.
 - b. Chilled Water 20° to 70°F.
 - 3. Furnish stainless steel wells for installation by Mechanical Contractor.

4. Locate all sensors in field with Owner/Engineer present.
 5. System accuracy for liquid temperature sensing shall be $\pm 1/2^\circ$.
 6. Sensors must be removable from wells.
- E. Outside Air Temperature and Humidity Sensor
1. Temperature
 - a. Range of -40° to 140°F .
 - b. Accuracy shall be $\pm 0.9^\circ\text{F}$
 - c. Encapsulated into Type 304 stainless steel tubes with low conductivity moisture proofing material and lag extension for thickness of insulation.
 2. Humidity
 - a. Capacitance element in the space or duct as required and output a 4 to 20 MA signal proportional to 0 to 100% RH to the DDC.
 - b. Accuracy shall be $\pm 2\%$
 - c. Range from 20 to 95% RH.
 - d. Relative humidity sensors shall have the sensing element of inorganic resistance media.
 3. Weatherproof sun shield consisting of multiple white plastic plates to reduce the thermal effects of the sun and increasing air flow between the plates.
 4. Sensor shall be mounted a minimum of 6" from all building structures.
 5. Minimum of 8' long leads.
 6. Provide manufacturers calibration certificate.
 7. Provide with a 5-year warranty
 8. Manufactured by ACI Model # A/-RH2-AN-O-SUN---NIST
- F. Freezer / Cooler Sensors
1. Thermistor with resistance of 10,000 ohms at 77°F .
 2. Accuracy shall be $\pm 1/2^\circ\text{F}$.
 3. Range of -40°F to 210°F .
 4. Provide manufacturers calibration certificate.
 2. Die cast aluminum construction
 3. Liquid tight wire connector to isolate sensor chamber from exterior temperature influence.
 4. 1/2" NPT threaded hub
 5. Mamac Systems Model #TE-205-F-12
 6. Reuse existing wiring penetrations through cooler or freezer where possible. If existing penetrations through cooler or freezers cannot be reused, seal existing holes with silicon such that opening is airtight.
 7. All new penetrations into the cooler or freezer body shall be sealed airtight using silicon. This shall include screw holes and wiring penetrations.

2.21 CURRENT SENSITIVE RELAYS

- A. Ensure compatibility with VFD applications for variable speed motor status.
1. Provide with adjustable set point.
 2. Relays must be mounted and not hung by power wires thru CT.
 3. Provide split-core type current sensors.
 4. Loop powered.
 5. LED Status.
 6. Acceptable Manufacturer: Veris Industries / Hawkeye
 7. Relays shall close status contacts in response to current flow in power leads to the equipment being monitored.
 8. To be used on towers, vertical turbine pumps, exhaust fans and direct drive equipment only.

2.22 DIFFERENTIAL PRESSURE TRANSDUCER

- A. Transducers to convert differential pressures to 4-20 MA analog outputs.
 - 1. Solid state pressure sensor with accuracy of +/- 1% of calibration range.
 - 2. Factory calibrated and have zero and span trimmers for field calibration.
 - 3. Range shall be selected to match the medium being monitored.
 - 4. Pressure snubbers to protect from pressure pulses and a 3-way bypass / valve assembly to protect the transducer from overpressure damage during start-up.
 - 5. LCD Display
 - 6. Acceptable Manufacturer: Rosemount 1151 or 3051 Pressure Transmitter

2.23 FLOW DIFFERENTIAL PRESSURE SWITCH

- A. The pressure sensing element shall be of the convoluted diaphragm type for sensitivity to system differential pressure.
 - 1. Select the pressure range based on the sensed differential pressure.
 - 2. The unit shall be protected against overpressure to the full static pressure rating.
 - 3. Accuracy: +/- 2% of full scale.
- B. Switch assembly.
 - 1. Reed switch.
 - 2. NEMA-4 enclosure.
 - 3. Threaded boss conduit entrance.
 - 4. SPST action.
 - 5. Voltage and rating as required for the control circuit.
- C. Wetted parts shall be made of type 303 stainless steel.
- D. Install an isolation valve in each sensing pipe leg to permit servicing without shutting the system down.

2.24 ELECTRIC REMOTE BULB THERMOSTAT

- A. Two position remote bulb thermostat:
 - 1. Bimetal controlled.
 - 2. Sealed mercury switches.
 - 3. Provide specified control action.
 - 4. Adjustment can be made by removing unit cover.
 - 5. Element with capillary length as required for the location.

2.25 ELECTRIC SPACE THERMOSTAT

- A. Two position space thermostat.
 - 1. Single Pole switch actuated by bi-metal sensing element.
 - 2. Range shall be 60°F to 90°F.
 - 3. Removable external knob adjustment means.

2.26 HIGH STATIC PRESSURE SWITCH

- A. With manual reset switch
 - 1. Approved manufacturer: Cleveland AFS-460.

2.27 INSERTION FLOW SENSORS

- A. Electromagnetic Flow Meter
 - 1. Retractable hot tap flow sensor

2. Accuracy: +/- 1% of full scale
3. Electromagnetic
4. Custom thread-o-let 400 psi / 250 degree F rated.
5. Line size from 1-1/4 to 72 inch
6. Metering range from 0.3 to 15 f/sec.
7. Remote NEMA 4 wall mounted LCD display
8. Field Pro Software & Communicator
9. Warranty two years
10. Approved Manufacturer Onicon Flow Meter F3500 or FT3500

2.28 CONTROL DAMPERS

- A. Opposed blade dampers:
1. Frames of 13-gauge galvanized sheet metal.
 2. Provisions for duct mounting.
 3. Damper blades not exceeding 8" in width.
 4. Blades of two sheets of 16-gauge galvanized sheet metal.
 5. Blades suitable for high velocity performance.
 6. Bearings of nylon or oil-impregnated, sintered bronze.
 7. Shafts of 1/2" zinc plated steel
 8. Leakage does not exceed 1/2% based on 2000 fpm and 4" static pressure.
 9. Replaceable resilient seals along top, bottom and sides of frame and blade edge.
 10. Submit leakage and flow characteristics data with shop drawings.
 11. Linkage shall be concealed out of the air stream within damper frame.
 12. Acceptable Model is Ruskin Model CD60.

2.29 PHOTO CELL CONTROL

- A. Light Sensitive Resistor:
1. 4-20 output or switch
 2. On = 3.0 / fc. Off 10.0 / fc
 3. UL Approved

2.30 DRAIN PAN FLOAT SWITCH

- A. Rated at 10 Amps:
1. Shuts off equipment if water level becomes too high.
 2. DPDT Contacts.

2.31 BY-PASS AUTOMATIC SHUT-OFF TIMERS

- A. Rated at 10 Amps, 125 VAC:
1. Shuts off equipment with timed switch
 2. White decorated timer
 3. Without hold feature
 4. Time Cycle 60 minutes

2.32 TEMPERATURE/CO₂ SENSOR

- A. Sensor combo in one housing, Temperature and CO₂.
- B. Provide combo temperature/CO₂ sensor in the following locations:
- a. Each Classroom
 - b. Library
 - c. Cafeteria

- d. Gymnasium
- C. 0-2,000 ppm CO2
- D. CO2 sensor shall have a self-calibration feature.
- E. Temperature accuracy shall be +/-1/2°F.
- F. Temperature range shall be 32° to 120° F
- G. Location and height to be approved by Architect/Engineer prior to installation.
- H. Internal RJ11 Communication jack at sensor for communications.
- I. Provide metal guards in the following locations:
 - a. Corridors
 - b. Cafeteria
 - c. Kitchen.
 - d. Gymnasium.
 - e. Dressing Rooms.
 - f. Industrial Labs.
- J. Color to be approved by Architect / Owner, submit sample for review.

2.33 AIR FLOW SENSING SWITCH

- A. The pressure sensing element shall be of the convoluted diaphragm type for sensitivity to system positive, negative, or differential pressure.
 - 1. Select the pressure range based on the sensed differential pressure.
 - 2. The unit shall be protected against overpressure to the full static pressure rating.
 - 3. Accuracy: +/- 2% of full scale
- B. Switch assembly:
 - 1. Reed switch
 - 2. Field adjustable setpoint
 - 3. Threaded boss conduit entrance
 - 4. SPST Action
 - 5. Voltage and rating as required for the control circuit

PART 3 – EXECUTION

3.1 INSTALLATION

- A. The control system shall be installed and final adjustments made by full-time employees of the factory-approved BMCS Building Management Control Subcontractor.
- B. The contractor shall collaborate through Architect / Engineer and Owner to determine the Owner's preference for naming conventions, etc. before entering the data in to the system.
- C. Due to actual operational or space conditions, it may be necessary for the Contractor to make sequence of operation modifications and/or controller adjustments, change the location or type of sensor to obtain proper operation and coverage of the system in each room or space. These change, if requested by the Owner or Engineer, shall be performed

at no additional cost to the Owner. Therefore, labor allowances should be made for such changes and adjustments if requested.

- D. The modification and expansion of the existing control system shall include removing any existing control wiring and devices associated with systems being removed.

3.3 INTERLOCK AND SAFETY CIRCUITS

- A. Close the outdoor air dampers when the related HVAC unit supply or exhaust fan is de-energized:
 - 1. The damper and actuators are specified in this section.
 - 2. Outdoor air damper shall be fully opened before related air handling unit fan is energized for 100% outside air use.
 - 3. Provide motorized outside air dampers for the following:
 - a. Supply fans
 - b. AHUs
 - c. Exhaust fans (except kitchen exhaust)
 - d. Outside air intakes
 - e. Relief air hoods
- B. Close the chilled and hot water valves to the coil when the related unit is de-energized.
- C. Interlock each chiller to start its dedicated chilled and condenser water pumps. Interlock pressure differential switch and pump auxiliary contacts in series to chiller safety terminal strip.
 - 1. On shutdown provide a circuit to permit the chilled water pumps and condenser water pumps to run while the chillers pump down as required by the manufacturer.
 - 2. As per manufacturer's recommendations.
- D. Primary chilled water control:
 - 1. Operating and safety controls are furnished as an integral part of the water-chilling unit and not specified in this section.
 - 2. Provide pressure differential switch located in the chilled water and condenser water piping to each water-cooled liquid chiller.
 - a) Interlock to prevent operation in the absence of flow.
 - b) This may not be the prime controller to start/stop the chiller.
 - c) Interlock thru pump auxiliary contacts.
 - 3. Provide a high limit temperature sensor in each primary chilled water pump loop.
- E. Exhaust/Supply Fans:
 - 1. Interlock the related exhaust and supply fans and the related outside air damper.
 - 2. Interlock the exhaust fans with the related air-handling unit through software. The new BMCS shall integrate all existing fan interlocks.
 - 3. Interlock related exhaust fan for dishwasher with time delay off relay.
 - 4. Interlock related exhaust fan for kiln with time delay off relay
 - 5. Interlock kitchen hood related supply and exhaust fans.
 - 6. Provide additional interlocks as indicated on fan schedule and on drawings.
 - 7. Interlock electrical and mechanical room exhaust fans with thermostat.
 - 8. Interlock refrigerant monitor with mechanical room purge system.
 - 9. Interlock science room related supply and exhaust fans.
 - 10. Interlock outside air supply fans for VAV air-handling unit with air-handling unit status point.
- F. Cooling Tower Fan Safety Interlock: Provide interlock wiring for the vibration sensor and

oil level switch on each cooling tower fan.

- G. Freeze Protection:
1. Provide a freeze protection sequence to ensure proper operation of equipment during a freeze condition not limited to the following:
 - a. Outside Air Handling Units & Supply Fans with heating and cooling coils: If unit is in occupied or unoccupied mode, upon the triggering of software point indicating a freeze condition or the low temperature sensor (freeze stat) indicates a freeze condition, the system will be disabled, close the outside air damper, open both heating and cooling valves to enable full flow condition. If heating coil discharge air sensor indicates a failure to control and is below setpoint then enable software point indicating a freeze condition, disable unit, close outside air damper, and open both heating and cooling valves to enable full flow condition. Ensure HW & CHW pumps are operational.
 - b. Boilers - Enable during a freeze condition.
 - c. Air Cooled Chillers – enable pumps, run cycle for 15 minutes per hour, open all chilled water valves.
 - d. Protect heating water coils downstream of DX cooling coil with freeze protection. If unit is in occupied or unoccupied mode, upon the triggering of software point indicating a freeze condition or the low temperature sensor (freeze stat) indicates a freeze condition, the system will be disabled, close the outside air damper, disable the DX cooling coil. If heating coil discharge air sensor indicates a failure to control and is below setpoint then enable software point indicating a freeze condition.
 2. Temperature low limit switch wired with double pole single throw switch with one switch leg hard-wired to de-energize fan and one switch leg to signal BMCS.
- H. Drain Pan Float Protection:
1. Interlock to shut down unit and close valves.
 2. Cooling Coils mounted above ceiling and in roof mounted units.
 3. Provide for each cooling coil location.
 4. Signal BMCS alarm point
- I. Condensing Hot Water Boilers:
1. Interlock each boiler to start its dedicated pump.
 2. Install communication cable between each boiler and master controller specified by boiler manufacturer.

3.4 GRAPHICS

- A. Furnish as-built drawings indicating finally corrected "as installed" diagram(s) of the complete Building Management Control System.
1. Modification of existing control systems shall be included.
 2. These must be as-built and any changes during the warranty period drawings must be revised and updated.
 3. Provide final sequence of operation in written format.
- B. Provide a set of the "as installed" diagram(s) of the complete control system laminated in plastic and hung in the main mechanical room or as directed by Owner.
- C. Provide a color-coded floor plan of the building showing the location of each system, and the area served by each AHU or related zone. These must be of professional quality. Floor plan is to hang in main mechanical room near central control panel.
- D. Provide computer graphics for each system.

- E. Provide final graphic room numbers as selected by District. Any changes during the warranty period shall be included.
- F. Provide a summary page for each type of equipment. Summary pages shall be provided for, but not limited to, DDB, EF, AHU, CH, CT, Pumps, and FCU. Summary pages shall include the ability to modify the global set points for each equipment type.
- G. Provide an alarm management and reporting graphical page. This page shall allow user to create, acknowledge and adjust alarms. All alarms shall have the ability to be selectable for remote notifications and control which personnel is notified.
- H. System shall include a graphical page that contains building and system related documents stored for ease of remote access.
- I. System shall include a real time dynamic dashboard to provide real time analysis of conditions and equipment performance.
- J. System shall include a real time dynamic Central Plant Energy / Status dashboard. Dashboard shall display the following at a minimum:
 - 1. Actual Plant operating Tons
 - 2. Total Plant Capacity Available
 - 3. Percent Usage of Available Capacity
 - 4. Current Plant operation KW/Ton
 - 5. Current Chiller KW/Ton
 - 6. Bar Chart indicating energy consumption by plant component (Chillers, CW Pumps, CHW Pumps and Exhaust Fans)
 - 7. Tables for Chillers, Chilled Water Pumps, Condenser Water Pumps, and Cooling Tower Fan. The chart shall indicate S/S, Status, KW Consumption, Alarm Status Running AMPS on Chillers.
 - 8. Trending Graph (Total Chiller KW/Ton and Total Plant KW/Ton)
- K. The modification and expansion of the existing control system shall include removing and updating all graphics to reflect equipment that has been added or removed.

3.5 IDENTIFICATION

- A. Provide a laminated engraved nameplate on all control panels and devices shown on the "as installed" control diagrams. Coordinate engraving with nomenclature used on the diagrams.
- B. A black-white-black laminated plastic engraved identifying nameplate shall be secured to each terminal cabinet, and control panels. Identifying nameplates shall have ½ inch high, engraved letters.
- C. A red-white-red 2"x8" laminated plastic engraved identifying nameplate shall be secured to each audible/visual alarm and emergency shutdown device. Provide identification and location of each A/V device laminated in plastic and hung at refrigerant monitor with identification, location of devices and proper operation of system in a graphic floor plan with written sequence of operation. Identifying nameplates shall have ½ inch high, engraved letters. A red-white-red 12"x12" laminated plastic engraved identifying nameplate shall be secured to outside of each door to machine room with "A REFRIGERANT LEAK HAS BEEN DETECTED IN THIS BUILDING WHEN AUDIBLE/VISUAL ALARM IS ENABLED. DO NOT ENTER. CONTACT MAINTENANCE DEPARTMENT."

3.6 WIRING FOR BUILDING MANAGEMENT AND CONTROL SYSTEMS

- A. Furnish and install all wire, conduit, raceways and cable systems required for the complete operation of the Building Management and Control System. In addition, furnish, and install all wire, conduit, raceways and cable systems required with the VRF system in the Administration area.
- B. All wiring for the Building Management and Control System is specified in this section and includes, but is not limited to:
 - 1. Wiring of interlock system.
 - 2. Wiring of control instruments.
 - 3. Wiring of control panels.
 - 4. Wiring of related power supplies, i.e. transformers.
 - 5. Wiring of 120 VAC power circuits for control panels and devices.
- C. All materials and methods specified in this section shall comply with the requirements specified in Division 26 of this specification.
- D. All power supply requirements shall be connected to the building electrical distribution system in an approved manner. Do not connect control equipment of circuits common with other building loads or devices.
- E. Temperature control wiring shall be jacketed cables installed with or without conduit as specified below or single conductors installed in conduit. Control wiring shall have minimum 300V insulation for low voltage wiring and 600V insulation for line voltage wiring.
- F. All line voltage control wiring, all low voltage control wiring which is exposed in the central plant, penthouse, and other exposed ceiling spaces; all low voltage control wiring which is routed through concealed inaccessible locations shall be installed in conduit.
- G. All low voltage control wiring which is routed through concealed accessible locations may be run without conduit provided that the wiring run without conduit is properly supported from the building structure on maximum 5' centers and does not depend upon the ceiling grid or the ceiling support system for support. Wiring run in plenum spaces shall be plenum rated. Support all plenum wiring in accessible locations in bridle rings, J-hooks, D rings. Plenum wiring is not to be supported within building structure or attached to conduit raceways. All low voltage wiring must be installed through supports. Wires shall be supported on 5' centers and identified at each termination point and at 50' centers minimum. Install wire parallel or perpendicular to the structural features of the building.
- H. Line and low voltage control wiring shall not be installed in the same conduit with control wiring and shall not be installed in the same conduit with power wiring.
- I. All wiring associated with building management and control system cover shall be as follows:
 - 1. Sensor jacket color, Green
 - 2. LAN communications, Yellow
 - 3. All THHN wiring shall comply with Division 26 insulation color identification

3.7 EXHAUST AND SUPPLY FANS

- A. Provide interlocks as scheduled on the plans unless shown on the electrical drawings.
- B. Provide BMCS override to disable operation of all exhaust and supply fans interlocked and/or specified throughout project.

- C. Dampers and actuators shall be provided by this contractor and shall not be furnished with the exhaust fan.

| POINT DESCRIPTION | TYPES | DEVICE |
|--------------------|-------|--|
| Start/Stop | DO | Control Relay |
| Fan Status | DI | Current Sensitive Relay (EF) Air Flow Sensing Switch (SF) |
| Outside Air Damper | DO | Electronic Operator |

3.8 KILN ROOM CONTROL

- A. This system consists of an exhaust fan and outside air intake. Controls shall be as follows:
 - 1. A line voltage twist time (12 HR w/o hold) shall energize the exhaust fan. The damper on the outside air intake shall interlocked with exhaust fan operation. A space temperature sensor shall, acting through the DDC panel, monitor the space temperature. If the space temperature rises above 130°F (adjustable) for 1 minute (adjustable), the kiln operation shall be disabled and an alarm shall be sent through the BMCS.

| POINT DESCRIPTION | TYPES | DEVICE |
|--------------------|-------|------------------------------|
| Fan Start/Stop | DO | Control Relay |
| Kiln Start/Stop | DO | Control Relay |
| Fan Status | DI | Current Sensitive Relay (EF) |
| Outside Air Damper | DO | Electronic Operator |

3.9 BUILDING ELECTRICAL USAGE

- A. Provide digital monitoring of the building KVA and KWH via all meters on main switch gear provided with electrical switchgear by Division 26
- B. Electrical Quality monitoring:
 - 1. Monitor Watts, VA, VAR, Demand, Imbalance, and Power Factor.
- C. Provide a separate graphics page for all Building Level meters. The link to the graphics page shall be categorized under Misc. Equipment.

3.10 CENTRAL PLANT CHILLED WATER SYSTEM ELECTRICAL USAGE

- A. Provide digital monitoring of the building KVA and KWH via all meters on switch gear serving central plant equipment provided with electrical switchgear by Division 26. This shall include all chilled water pumps (primary and secondary), tower fans, condenser water pumps, chillers, etc. The BMCS shall perform all necessary calculations to remove or add meters as required to capture only the chilled water system related components. Provide a separate graphics page that indicates instantaneous chilled water plant power

consumption and the trend data for the past 90 days minimum.

- B. Electrical Quality monitoring:
 - 1. Monitor Watts, VA, VAR, Demand, Imbalance, and Power Factor.
- C. Provide a separate graphics page for all Central Plant Chilled Water System electrical switchgear meters. The graphics page shall indicate a panel directory of what is connected to the panel. The link to the graphics page shall be categorized under Misc. Equipment.

3.11 MISCELLANEOUS

- A. MDF/IDF Temperature Sensor: Provide a temperature sensor in each MDF and IDF rooms to monitor space conditions. BMCS shall alarm when temperature is out of setpoint range.

| POINT DESCRIPTION | TYPE | DEVICE |
|---------------------|------|--------------|
| MDF/IDF Temperature | AI | Space Sensor |

- B. Specialized Storage Rooms: Provide a temperature and humidity sensor in each specialized storage room to monitor space conditions. BMCS shall alarm when temperature and humidity is out of setpoint range.

| POINT DESCRIPTION | TYPE | DEVICE |
|---------------------|------|-----------------------|
| Storage Temperature | AI | Space Temp Sensor |
| Storage Humidity | AI | Space Humidity Sensor |

- C. Outside Air:
 - 1. Provide a temperature sensor and humidity sensor to monitor outside air conditions.
 - 2. The BMCS control system shall reference the nearest airport weather data to verify BMCS sensor accuracy by comparing the local sensor readings to the airport conditions. If the values vary my more than 10% (Adjustable) an alarm shall be sent through the BMCS that local sensors are out of range and need to be re-calibrated.

| POINT DESCRIPTION | TYPE | DEVICE |
|---------------------|------|-----------------|
| Outside Temperature | AI | Thermistor |
| Outside Humidity | AI | Humidity Sensor |

- D. Photocell: Provide a photo sensor mounted on the north side of the building. Location is to be approved by Owner / Architect / Engineer.

| POINT DESCRIPTION | TYPE | DEVICE |
|-------------------|------|---------|
| Photocell | AI | Contact |

E. Interior Lighting Control:

Building Management Control System Scope

The lighting control system, as indicated on the electrical drawings lighting control details, will be provided with lighting control system BMCS interface devices via DLM room controllers, refer to Electrical Drawings and Details. The BMCS system shall send a occupied and unoccupied signal to the lighting control system BMCS interface devices based on a BMCS schedule.

The BMCS provider shall provide an additional 8 hours of technician support to ensure the lighting control system is commissioned and operating as described.

Lighting Control System Scope

When the Lighting Control system BMCS interface devices in an area receives an occupied signal from BMCS, the lights in that area shall remain in their current state (typically off) but allow any local switch in that area to control the lighting in that space.

When the Lighting Control system receives an unoccupied signal from BMCS, the lighting control system shall flash the lights, and after a delay, the lights in that area shall be swept off by the lighting control system. In this unoccupied mode, the lighting control system shall allow any local light switch in that area to allow the lights to be controlled locally for 2-hours upon being switched on by the local switch. After the 2-hours, the lighting control system enable signal shall expire, and the lights shall again flash a warning, and if the local switch is not again activated, the lights shall be turned off by the lighting control system.

| POINT DESCRIPTION | TYPE | DEVICE |
|---------------------------|------|---------------------|
| Interior Lighting Control | | DLM Room Controller |

F. Exterior Lighting Control

1. Provide individual time/photo-cell and time based control of each lighting contactor specified in Division 26.
 - a. Provide separate control of each contactor.
2. The exterior lights shall be controlled by the BMCS using both a combination of photosensor, time schedules and astronomical sunrise/sunset. The exterior lights shall automatically come on when the sun sets based on the longitude and latitude coordinates of the facility (adjustable +/- 30 minutes). At 11 p.m. (adjustable) the time schedule shall turn off the exterior lights. At 4:00 a.m. (adjustable) the exterior lights shall automatically turn on based on time schedule. Upon sunrise, which shall be based on longitude / latitude of the facility the exterior lights shall turn off.
3. Between sunrise and sunset, photo-sensor shall only deactivate all exterior lighting when ambient light levels are above set point (adjustable).

| POINT DESCRIPTION | TYPE | DEVICE |
|--------------------------|------|---------------|
| Lighting Contactor | DO | Control Relay |
| Momentary Control Switch | DI | Switch |

G. Tennis Court Lighting Control: The controls for AUTO shall accept a signal from the Building Management Control System (BMCS) for control of the tennis court lighting. The

BMCS signal used for the interior lighting Wattstopper controls building occupied/un-occupied state shall enable/disable a BMCS tennis court lighting scheduled. The tennis court lighting shall turn ON 20-minutes prior to sunset and turn off at a scheduled time as directed by Owner. Either a building Wattstopper un-occupied state or a tennis court scheduled turn OFF shall turn the tennis court lights OFF.

- H. The new athletic storage building shall be controlled locally and shall not be part of the BMCS system.

3.12 TERMINAL UNIT COORDINATION

- A. Equipment furnished in this section and installed by Section 23 36 16:
 1. Automatic temperature control card (DDC).
 2. Damper Actuator
- B. Equipment furnished and installed by Section 23 36 16:
 1. Damper.
 2. Multi-point flow sensor.
 3. Power transformer.
 4. Controller enclosure.

3.13 DUAL DUCT VARIABLE VOLUME AIR HANDLING UNITS WITH SPLIT DEHUMIDIFICATION UNIT MOUNTED ON TOP (AHU-G5)

- A. Split dehumidification units are furnished with a chilled water coil and a hot water heating coil in the PREHEAT position and supply fan. Control shall be as follows:
 1. A duct mounted sensor sensing supply air temperature shall, acting through the Direct Digital Control Panel, modulate the valve on the cooling coil and the valve on the hot water coil, in sequence, to maintain the desired discharge air temperature as scheduled. The supply fan shall be started and stopped from the BMCS System.
 2. Provide a temperature low limit switch located on the discharge side of the hot water preheat coil or the entering side of the cooling coil to de-energize the air handling unit and supply fan, close the outside air damper, open the hot water valve 100%, start the boiler and hot water pump, signal an alarm to the BMCS when the temperature drops below 32°F. Device shall be manual reset.
 3. Open OA damper and start supply fan before starting Air Handling Unit. Provide end switch to ensure damper is in the open position in either the manual (hand) or auto position of the motor starter.

| POINT DESCRIPTION | TYPES | DEVICE |
|--------------------------------|-------|-------------------------|
| Supply Fan Start/Stop | DO | Control Relay |
| AHU Status | DI | Current Sensitive Relay |
| Variable Speed Fan | AO | Motor Controller |
| Cooling Coil Leaving Air Temp. | AI | Averaging Sensor |
| Heating Coil Leaving Air Temp. | AI | Averaging Sensor |
| CHW Valve | AO | Electronic Operator |

| POINT DESCRIPTION | TYPES | DEVICE |
|--------------------|-------|------------------------------|
| Outside Air Damper | DO | Electronic Operator |
| Freeze Status | DI | Temperature Low Limit Switch |
| HW Pre Heat Valve | AO | Electronic Operator |

- B. Units consist of a chilled water coil, a hot water coil, a fan, and a variable speed drive. Controls shall be as follows:
1. An electronic averaging duct sensor in the cold duct shall, acting through the DDC System, modulate the chilled water valve to maintain desired setpoint. An electronic averaging duct sensor in the hot deck shall, acting through the DDC system, modulate the hot water valve to maintain desired setpoint. A schedule shall be set up for the hot deck temperature based on outside air temperature. The temperature of the hot deck shall modulate between the following criteria. If the temperature outside is 50°F (adjustable) or below, the hot deck temperature shall be 95°F; if the outside temperature is 75°F or above, the hot deck coil shall be deactivated.
 2. The unit shall be started and stopped from the BMCS system.
 3. An electronic duct static pressure sensor shall be located in the cold duct at a position approximately 2/3 the distance from the fan in the longest duct run. Location is to be approved by Engineer and coordinated with Section 23 05 93. The sensor shall transmit a signal to the supply fan motor speed controller, and modulate the fan speed to maintain a supply duct static pressure. A high limit static pressure sensor with manual reset, located at the fan discharge, shall de-energize the supply fan when sensing pressure above duct construction capabilities. Fan start-up shall be initiated at minimum air speed.

| POINT DESCRIPTION | TYPE | DEVICE |
|-------------------------------|------|---|
| Start/Stop | DO | Control Relay |
| AHU Status | DI | Air Flow Sensing Switch |
| Discharge Air Temperature (2) | AI | Duct Temperature Sensor, One Each Deck |
| HW Coil Leaving Air Temp. | AI | Averaging Duct Thermistor |
| CHW Coil Leaving Air Temp. | AI | Averaging Duct Thermistor |
| Return Air Temp. | AI | Averaging Duct Thermistor |
| HW Valve | AO | Electronic Operator |
| CHW Valve | AO | Electronic Operator |
| Duct Static Pressure (2) | AI | Static Pressure Sensor, One Each Deck |
| Fan Speed | AO | Variable Frequency Drive |

3.14 DOUBLE DUCT VARIABLE VOLUME TERMINAL UNITS

- A. Each unit shall consist of two pressure independent variable volume dampers, one on each duct inlet connection. Controls shall be as follows:
1. A space temperature sensor shall, through the direct digital control system, modulate the variable volume damper on the cold deck from full open to 40% air flow rate to maintain room setpoint. When heating is required, the temperature sensor shall first modulate the variable volume damper on the hot duct and cold deck while maintaining 40% airflow. If more heating is required, the temperature sensor shall modulate the variable volume damper on the hot deck from 40% to full open to maintain room setpoint.
 2. The BMCS Contractor shall furnish the terminal box manufacturer with a controller to be factory mounted. The controller shall display cfm, temperature, and damper position.
 3. The BMCS Contractor shall furnish the terminal box manufacturer the control flow diagram for correct mounting of flow measurement devices, wiring of actuators, and terminal equipment controllers.

| POINT DESCRIPTION | TYPE | DEVICE |
|-------------------|------|---------------------------------|
| Space Temperature | AI | Temperature |
| Primary Air (2) | AO | Variable Volume Damper Operator |
| CFM Flow | AI | Control Panel |

3.15 FAN COIL UNITS

- A. Each fan coil unit is furnished with a chilled water coil and hot water coil. Control shall be as follows:
1. A space temperature sensor shall, acting through a terminal equipment controller, modulate the valves on the chilled water cooling coil and hot water reheat coil in sequence to maintain the desired space temperatures.
 2. Start/stop of fan coil unit shall be by terminal equipment controller.
 3. The outside air units providing the outside air shall be activated when the fan coil units are operating during the occupied periods.

| POINT DESCRIPTION | TYPES | DEVICE |
|---------------------------|-------|-------------------------|
| Start/Stop | DO | Control Relay |
| FCU Status | DI | Air Flow Sensing Switch |
| CHW Valve | AO | Electronic Operator |
| HW valve | AO | Electronic Operator |
| Space Temperature | AI | Space Thermistor |
| Discharge Air Temperature | AI | Duct Thermistor |

3.16 CHILLED WATER SYSTEM CONTROL

- A. The existing chillers, pumps and portions of the chilled water piping are being replaced.

The existing controls sequence shall be reused. All controls end devices shall be replaced as listed in the points list below. In addition, central plant controllers and wiring shall be replaced with new. Existing conduit shall be reused and extended.

- B. Provide new graphics as part of the central plant controls upgrades.
- C. This contractor shall remove all existing controls to allow for installation of new chilled water system.
- D. All controls equipment/devices, sequences for the thermal storage tank shall remain and be reused. Including the normally closed thermal storage tank motorized isolation valves. Terminate existing wiring in new central plant controllers and provide full checkout for thermal storage system.
- E. Provide time delays between pump starts and stops to allow system to stabilize.
- F. Change lead/lag rotation on a weekly basis.
- G. Provide interface to each chiller through the chiller BacNet interface card. Provide a graphic page for the interface card that displays all values available.

| POINT DESCRIPTION | TYPES | DEVICE |
|----------------------------------|-------|---------------------|
| Chiller Start/Stop | DO | Control Relay |
| Secondary Pump Start/Stop | DO | Control Relay |
| Chiller CHW Isolation Valve | DO | Electronic Operator |
| Primary CHW supply Temp. | AI | Pipe RTD |
| Primary CHW supply Temp. | AI | Pipe RTD |
| Chiller CHW Supply Temperature | AI | Pipe RTD |
| Chiller CHW Return Temperature | AI | Pipe RTD |
| Chiller CW Supply Temperature | AI | Pipe RTD |
| Chiller CW Return Temperature | AI | Pipe RTD |
| Secondary CHW supply Temp. | AI | Pipe RTD |
| Secondary CHW supply Temp. | AI | Pipe RTD |
| System CHW Differential Pressure | AI | Pressure Sensor |
| System CHW Flow | AI | Flow Meter |
| Decoupler Flow | AI | Flow Meter |
| Decoupler Water Temperature | AI | Pipe RTD |
| | | |

| POINT DESCRIPTION | TYPES | DEVICE |
|--|-------|------------------------------|
| Chiller CW Differential Pressure | AI | Differential Pressure Sensor |
| Common CW Supply Temperature | AI | Pipe RTD |
| Chiller AMPS | DI | Current Sensor |
| Chiller Alarm Status | DI | Contact |
| Primary Pump Status | DI | Differential Pressure Switch |
| Secondary Pump Status | DI | Differential Pressure Switch |
| Chiller CHW Flow Status | DI | Differential Pressure Switch |
| Chiller CW Flow Status | DI | Differential Pressure Switch |
| System CHW Bypass Valve | AO | Electronic Operator |
| Chiller Reset | AO | Chiller Control Module |
| CHW Return Valve | AO | Electronic Operator |
| Secondary Hot Water Pump Start/Stop/Modulation | AO | VFD (Each Pump) |
| Chiller CW Flow Control Valve | AO | Electronic Operator |
| Primary Pump Start/Stop | AO | VFD (Each Pump) |

3.17 CONDENSER WATER CONTROL

- A. The existing cooling tower, condenser water pumps, piping and motorized isolation and bypass valves are being replaced. The new cooling tower will be a three-cell cooling tower with three vertical turbine condenser water pumps. The condenser water pumps are headered and each cooling tower and each chiller shall be provided with condenser water isolation valves. Alternate the lead condenser water pump on a daily basis. Provide all new valves and controls for the new condenser water system.
- B. This contractor shall remove all existing controls to allow for installation of new condenser water system.
- C. A sensor located in the condenser water supply shall, through a DDC panel:
 - 1. Open the chiller condenser water isolation valve.
 - 2. Open cooling tower condenser water isolation valves. Water shall be allowed to flow over multiple towers when a minimum of two condenser water pumps are energized. When only one condenser water pump is energized, the flow should be limited to only flow over two towers.
 - 3. Modulate the bypass valve located in the condenser water piping.
 - 4. When the bypass control valve is in the full cooling position with all the water flowing over the tower and no water being by-passed enable the tower fan.
 - 5. Modulate the tower fans to maintain water temperature entering each condenser at 85°F (adjustable)
 - 6. As the temperature decreases modulate the fan speed and modulate the bypass

valve to maintain setpoint.

- D. Based on the outdoor ambient air temperature and relative humidity the BMCS shall calculate the ambient wet bulb temperature. The condenser water set point temperature to be equal to the sum of the wet bulb temperature and the cooling tower approach temperature. The range of acceptable condenser water temperatures shall be set as recommended by the chiller manufacturer.
- E. Provide full automatic control of the entering condenser water temperature on initial chiller start-up.
- F. Close the two way cooling tower isolation valve and the two way chiller condenser water isolation valve when pumps or towers are disabled.
- G. The variable frequency drives on the condenser water pumps shall be utilized for soft start and balancing only.

| POINT DESCRIPTION | TYPE | DEVICE |
|---|------|------------------------------|
| Start/Stop Pump | DO | Control Relay |
| Start/Stop (Tower Fan) | DO | Control Relay |
| Status (Tower Fan) | DI | Current Switch |
| Vibration Alarm | DI | Vibration Switch |
| Low Oil Level Alarm | DI | Oil Level Switch |
| CT speed (Each Tower) | AO | Variable Frequency Drive |
| Tower Bypass Valve | AO | Electronic Operator |
| Pump VFD (Each pump) | AO | Variable Frequency Drive |
| Status (Pumps) | DI | Differential Pressure Switch |
| Cooling Tower Isolation Valve (Inlet Each Tower) | AO | Electronic Operator |
| Chiller Condenser Water Isolation Valve (Each Chiller) | AO | Electronic Operator |

3.18 CHEMICAL TREATMENT SYSTEM

- A. Monitor water treatment power circuit and alarm contacts from water treatment controllers. Provide with cooling tower systems only.

3.19 HYDRONIC HOT WATER HEATING SYSTEM

- A. This system consists of five condensing hot water boilers with constant flow primary boiler pumps and two variable flow hot water secondary pumps. Control of the hydronic hot water heating system is as follows:
 1. Energize the hydronic hot water heating system whenever there is a call for heating in the building.

2.
 - a. Monitor all control valves to determine if a heating requirement exists.
 - a. Energize the hybrid sequence controller specified elsewhere.
 - a. The hybrid sequence controller shall control all functions and sequencing of the hot water heating boilers.
 - b. Connect all boilers to the master boiler controller specified elsewhere with communication cable as required.
 3. Hydronic hot water heating system supply temperature reset.
 - a. A temperature sensor sensing outdoor temperature shall provide an input to the hybrid sequence controller to reset the hot water supply temperature.
 - 1) Maintain 140°F supply water temperature whenever the ambient temperature is 20°F and below.
 - 2) Maintain 110°F supply water temperature whenever the ambient temperature is 60°F and above.
 - 3) All reset temperatures shall be adjustable through the BMCS.
 4. Secondary hot water pump control:
 - a. A system differential pressure sensor shall modulate the hot water pump variable frequency drives and stage pumps A and B to maintain system differential pressure.
 - b. This system shall be completely adjustable in the field.
 5. Boiler Carbon Monoxide Detector shall be wired to shutdown the boiler upon activation. If Co detector is activated the boiler shall not operate in all modes, hand and auto. BMCS contractor to provide 2 hours of technician support to coordinate commissioning of detector and ensure boiler is shut down upon Co detector activation.
- B. Provide new controls for new boiler system. This shall include wiring, controllers and end devices.
- C. Provide interface to each boiler through the boiler interface card. Provide a graphic page for the interface card that displays all values available.

| POINT DESCRIPTION | TYPES | DEVICE |
|--|-------|--------------------------------------|
| Hybrid Sequence Controller | DO | Control Relay |
| Boiler Alarm Status | DI | Safety Relay (Each Boiler) |
| Secondary Hot Water Pump Start/Stop/Modulation | AO | Variable Frequency Drive (Each Pump) |
| Pump Status | DI | Differential Pressure Switch |
| Building Hot Water Supply/Return Temperature | AI | Pipe RTD |
| Boiler Discharge Water Temperature | AI | Pipe RTD (Each Boiler) |
| Ambient Temperature | AI | Thermistor |
| System Differential Pressure | AI | Pressure Sensor |
| Boiler Supply Water Reset | AO | Hybrid Sequence Controller |
| Inlet Temperature (Read Only | | Bacnet Card (Each Boiler) |

| POINT DESCRIPTION | TYPES | DEVICE |
|--------------------------------|-------|---------------------------|
| Outlet Temperature (Read Only) | | Bacnet Card (Each Boiler) |
| Header Temperature (Read Only) | | Bacnet Card (Each Boiler) |
| Boiler State (Read Only) | | Bacnet Card (Each Boiler) |
| Error Code (Read Only) | | Bacnet Card (Each Boiler) |

3.20 HYDRONIC AND DOMESTIC BOILER CO MONITOR SYSTEM

- A. This contractor shall provide and wire interlocks from equipment to the CO monitor system. Upon alarm through the sensor all the boiler equipment, i.e. boiler and pumps and domestic water heaters, shall be deactivated. CO monitor shall provide a visual and audible alarm. Provide a sign at each entrance to boiler room to indicate information about system.
- C. Upon Alarm of CO monitor, notify users via text message.
- D. CO Monitor control shall be provided at each room that contains gas fired hydronic boilers or domestic water heaters/boilers.

| POINT DESCRIPTION | TYPES | DEVICE |
|-------------------|-------|---------------|
| CO Monitor | DI | Control Panel |
| System Start/Stop | DO | Control Relay |

3.21 REFRIGERANT MONITORING / VENTILATION CENTRAL PLANT APPLICATIONS

- A. Replace the existing refrigerant monitor in the central plant and other locations as required by code as part of the central plant control system upgrade.
- B. Monitor the concentration of refrigerant through an analog input signal through the BMCS. Install (2) sensors at each chiller at opposite ends. Alarm levels of refrigerant concentrations are provided in the Code. Refrigerant levels shall be available at the BMCS.
- B. Install audible and visual alarms in the area served, at locations as required by code. Audible sound pressure level of at least 15Dba above the operating ambient noise level within machine room and provide a distinctive strobe type visual alarm both inside and outside machine room at each entrance. Ceiling mounted rotating beacon in center of machine room. Strobes shall be provided immediately adjacent to and outside of each refrigeration machinery room exit. Provide visual and audible device installed at locations as per local code.
- C. Provide a clearly identified switches of the break-glass type immediately adjacent to inside and outside of each refrigeration machinery room exit for emergency and activation of the emergency exhaust system and equipment shutdown i.e. chillers and pumps thru safety circuits upon alarm. Mechanical equipment shall be shut down in an orderly manner so as not to damage the equipment. Label switches / buttons per Code.

- D. Provide a separate emergency ventilation buttons located on the inside the building adjacent to each refrigeration machinery room exit for activation of the central plant emergency ventilation system. Upon alarm either through the refrigerant monitor, by manually pushing the central plant emergency exhaust button or pressing the glass break type switch, the emergency exhaust fan shall be modulated to full speed via the VFD. Label switches / buttons per Code.
- E. Activation of emergency exhaust and equipment shutdown shall signal an alarm to the BMCS and signal the audible and visual alarms in the area served.
- F. During normal plant operation the plant exhaust fan shall operate via the VFD at minimum speed as scheduled to provide general plant exhaust.

| POINT DESCRIPTION | TYPE | DEVICE |
|-------------------------------|------|------------------------------|
| Refrigerant Monitor / Sensors | AI | Control Panel |
| Emergency Shut | DI | Break Glass Switch |
| Emergency Ventilation | DI | Emergency Ventilation Button |
| Fan Start/Stop | DO | Control Relay |
| Fan Status | DI | Current Switch |
| Variable Speed Motor | AO | Motor Controller |
| System Start/Stop | DO | Control Relay |

3.22 START-UP AND POINT VERIFICATION

- A. Final startup and point verification shall include the following information.
 - 1. Field panel checkout:
 - a. Verify enclosure is not mounted on vibrating surface.
 - b. Verify class I and class II wiring is separated within enclosure.
 - c. Check for shorts/grounds/induced voltages/proper voltages.
 - d. Verify proper point terminations in accordance with as-builts.
 - e. Verify that all modules are in proper place and addressed.
 - f. Verify proper power voltage.
 - g. Load database and programming.
 - h. Startup the panel.
 - i. Point and device checkout.
 - 2. Analog input point checkout:
 - a. Verify the correct wiring terminations per the design documentation package, at the field panel. Verify that all wiring and terminations are neat and dressed.
 - b. Verify the point address by checking that the analog input instrument is wired to the correct piece of field equipment. Do this by altering the environment at the sensing element or by disconnecting one of the wires at the sensor, and verifying that the reading at the field panel has reacted to this change.

- c. Verify the point database to be correct, (i.e., alarmability, alarm limits, slope/intercept, engineering units, etc.). Verify that the correct change of value (COV) limit has been defined.
 - d. Verify the sensor has the correct range and input signal. (i.e., 20-120°F, 4 - 20 ma). Verify that the device is mounted in the correct location and is wired and installed correctly per the design documentation package.
 - e. Set-up and/or calibrate any associated equipment (i.e., panel LCD meters, loop isolators, etc.). Verify that these auxiliary devices are mounted in the correct location and are wired and installed correctly per the design documentation package.
 - f. Verify the correct reading at the field panel using appropriate MMI devices. Verify that any associated LCD panel meters indicate the correct measured value.
3. Digital input point checkout:
- a. Verify the device is correctly wired and terminated as shown in the design documentation package. Verify that all wiring and terminations are neat and properly secured.
 - b. Verify the point address by verifying that the digital input is correctly terminated at the controlled piece of equipment.
 - c. Verify the point database is correct (i.e., point name, address, alarmability, etc.).
 - d. Set-up and/or calibrate the associated equipment, i.e. smoke detector, high/low temp detector, high/low static switch, flow switch, end switch, current relay, pressure switch, etc. is mounted in the correct location, and is wired and installed correctly per the control system installation drawings.
 - e. With the controlled equipment running or energized as described in the digital output checkout procedures, verify the correct operation of the digital input point and associated equipment by putting the digital input monitored equipment into its two states. Verify that the proof or status point indicates the correct value at the operator's terminal and that the status led is giving the proper indication in each mode of operation (on/off).
4. Digital output point checkout:
- a. Verify that device is correctly wired and terminated as shown in the design documentation package.
 - b. Verify that the correct voltage is utilized in the circuit.
 - c. Verify the point database to be correct (i.e. point name, address, etc.).
 - d. Check and verify that the end device responds appropriately to the digital output(s).
 - e. After verifying the set-up and operation of any associated digital input/proof points, check and verify correct operation of the logical point and associated equipment by commanding the point to all possible states (i.e. off, on, fast, slow, auto, etc.). Verify that the defined proof delay is adequate for all modes of operation.
 - f. If any interlocked equipment exists that has independent hand-off-auto or auxiliary control wiring, verify correct operation of same. Also check that any interlocked equipment such as EP switches for damper operation or exhaust and return fans are wired correctly and operate correctly.
 - g. Verify that the controlled piece or pieces of equipment cannot be caused to change state via the digital output if an associated hand-off-auto switch is in the hand/on or hand/off mode of operation, unless specified as a fireman's override point etc.

5. Analog output point checkout:
 - a. Verify the correct wiring or piping terminations per the design documentation package, at the field panel. Verify that all wiring and piping terminations are neat and dressed.
 - b. Insure that the correct output device(s) are installed per the Control System Installation Drawings. (i.e., I/P or P/I transducers, transformers, power supply, etc.). Verify that these devices are installed, wired and piped correctly. Verify that any configuration jumpers are in the proper settings for the required application. Verify related transformers are fused in accordance with installation drawings.
 - c. Verify the point database to be correct. Verify that the correct COV limit has been defined.
 - d. Verify the point address by checking that the analog output is wired and/or piped to the correct output transducer and/or equipment.
 - e. Verify that the controlled device is calibrated (i.e., 3-8PSI valve, 8-13 PSI damper motor, 4-20 ma variable frequency drive, etc.) and is in the correct location, and is wired or piped and installed correctly per the design documentation package. If the controlled device is not calibrated, then a three-point (high, low and mid-point) calibration procedure must take place. Verify proper operation of the end device. When calibration has been verified, ensure that installation drawings, point database, and PPCL have been updated.
 - f. Set-up and or calibrate any associated equipment, (i.e., panel LCD meters, loop isolators, pneumatic gauges, etc.). Also verify that these auxiliary devices are mounted in the correct location, and are wired or piped and installed correctly per the design documentation package.
 - g. After verifying the set-up and operation of any associated equipment check for the correct operation of the logical point and associated equipment by commanding the analog output to the top and bottom of its range. Verify that the control device(s) responded appropriately as indicated by the design documentation package. Check to insure that all network terminals, host console devices, etc. can also command these outputs.
 - h. Check that all pneumatic gauges, pilot positioners and LCD panel meters indicate the correct values.
6. Terminal equipment controller checkout:
 - a. Load program database
 - b. Enable programs
 - c. Verify sequence of operations
7. Programming checkout:
 - a. Provide checkout for each system and sequence of operation.
 - b. The following are sample sequence of operations tests. The intent of these procedures is to provide a plan of action to verify system operations via block checks of the project specific sequence of operations. The procedures may be used in this format, or one procedure to a page should more detail be required. The procedures outlined below should be verified for accuracy, and may be modified to meet your specific requirements.
 - c. Description of Test: AHU Alarm Checkout. Verify AHU-1 discharge air temperature alarming is operational and is received at the designated terminal.
 - d. Input to Trigger Test: Change discharge temperature high alarm limit through software to a value below the current discharge temperature

- (discharge temperature - 10°F).
- e. Expected Outcome: A high temperature alarm will be received per the Alarm Definition Report at its designated terminal.
 - f. Provide signoff sheet with indication for test Pass, Fail, Date of test and Initials for signoff.
8. Workstation checkout:
- a. Verify the operation of all trunk interface equipment.
 - b. Verify all workstation software, including options, based upon the installation instructions for the PC.
 - c. Perform software backup (site, options, etc.)
 - d. Complete workstation configuration report for owner signoff.
 - e. Provide verification that all graphics have been created, as required by project bid documents.

3.23 TESTING AND ACCEPTANCE

- A. General:
1. After completion of installation and start-up procedures, commence the specified 3-phase verification and testing sequence leading to final acceptance.
 - a. Follow in the order specified.
 - b. Each testing phase shall be satisfactorily completed before entering the next phase.
 2. Prior to entering each phase of the sequence, submit for approval, a written agenda describing in detail the procedure to be followed to meet the requirements for each specified verification, test or demonstration.
 3. Submit for approval, a sample of the form on which the test will be reported.
 - a. Identify project.
 - b. Provide a list of all points, arrange in numerical order of point addresses.
 - 1) Show point descriptor and location of each.
 - 2) Indicate DDC panel that processes each point.
 - 3) Use the list as a basis for the specified report form.
 - c. Signatures of participants and observers.
 - d. Results.
 - e. Description of adjustment or corrections of points in error.
 - f. Date.
 4. Provide schedule of tests. Estimate dates of significant events.
 5. Test, calibrate and adjust each point in the system as specified.
 6. Provide documentation of all tests and verifications as specified.
 7. Provide trend reports indicating proper control of all points for an extended period of time.
- B. Phase 1 - Testing, Calibrating, and Adjusting:
1. Operate each analog point in the entire system.
 - a. At a point in the upper quarter of its range.
 - b. At a point in the lower quarter of its range.
 - c. At its operating point.
 2. Provide personnel and diagnostic instruments at both the central and remote locations.
 3. Provide testing stimulants for alarms.
 4. Use digital meters of double the accuracy of the instruments being calibrated.
 5. Provide an approved test device for simulating high and low temperatures.
 6. When the function is performed, read values at the central control and observe the actual function at the field instrument.
 7. Exercise each binary point and observe indication at console and simultaneously

- observe operation in the field.
 - 8. Submit an operation report for each point in the system, in approved format, and describe any corrective or adjusting action taken.
 - 9. Test all power transducers with a Dranetz Power Analyzer.
- C. Phase 2 - Equipment and Point Verification:
- 1. Verify calibration or function of each point.
 - a. Verify analog points at operating value.
 - b. Record on specified form.
 - c. Make approved adjustments to out of tolerance points.
 - 1) Identify these points for ready reference.
 - 2. After verification procedure in completed:
 - a. Verify corrected points.
 - b. Record on specified form.
 - c. Points requiring correction.
 - 1) Replace sensor or actuator if electrical measurements indicated components are out of specified tolerance.
- D. Phase 3 - Software Verification:
- 1. Submit agenda and report format for software demonstrations.
 - 2. Demonstrate to the Owner and the Engineer that all software programs and automatic control sequences function as specified.
 - 3. Demonstrate compliance with response time specifications.
 - a. Simulate normal heavy load conditions.
 - b. Initiate at least ten successive occurrences on normal heavy load conditions as specified, and measure response time of typical alarms and status changes.
 - 4. Provide written documentation of demonstration, signed by representatives of the Contractor and Engineer.
- E. Provide the following reports to Engineer at final completion of all Testing:
- 1. List of all points.
 - 2. List of all points currently in alarm.
 - 3. List of all disabled points.
 - 4. List of all points in over-ride status.
 - 5. List of all points currently locked out.
 - 6. List of user accounts and access levels.
 - 7. List all weekly schedules.
 - 8. List of holiday programming schedules.
 - 9. List of limits and deadbands.
 - 10. System diagnostics reports including, list of DDC panels on line and communicating, status of all DDC terminal units device points.
 - 11. List of programs.
 - 12. Provide trend data reports to ensure proper operation and sequence control of BMCS.
- F. Substantial Completion of the BMCS will not occur until completion and acceptance of all testing and acceptance procedures.

3.24 TRAINING

- A. The contractor shall provide factory-trained instructor to give full instruction to designated personnel in the operation of the system installed. Instructors shall be thoroughly familiar with all aspects of the subject matter they are to teach. The contractor shall provide all students with a student binder containing product specific training modules for the system

installed. All training shall be held during normal working hours of 8:00 am to 4:30 PM weekdays.

- B. Provide 40 hours of training for Owner's designated operating personnel. Training shall include:
 - Explanation of drawings, operations and maintenance manuals
 - Walk-through of the job to locate control components
 - Operator workstation and peripherals
 - DDC controller and ASC operation/function
 - Operator control functions including graphic generation and field panel programming
 - Operation of portable operator's terminal
 - Explanation of adjustment, calibration and replacement procedures
 - Student binder with training modules

- C. Since the Owner may require personnel to have more comprehensive understanding of the hardware and software, additional training must be available from the Contractor.

3.25 PROJECT MANAGEMENT

- A. Provide a designated project manager who will be responsible for the following:
 - 1. Construct and maintain project schedule.
 - 2. Authorized to accept and execute orders or instructions from General Contractor, Owner / Architect & Engineer.
 - 3. Attend project meetings as necessary to avoid conflict and delays.
 - 4. Make necessary field decisions relating to this section.
 - 5. Coordination / Single point contact.
 - 6. Have Internet access for project management.

END OF SECTION

**SECTION 23 09 34 - COORDINATION OF BUILDING MANAGEMENT
AND CONTROL SYSTEM**

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. The Building Management and control System for the facility is being replaced. The items listed below shall be furnished and/or installed by this contractor.

PART 2 - PRODUCTS

- A. Products provided by the Building Management and Control System (BMCS) Contractor.
 - 1. Control Valves
 - 2. Dampers
 - 3. Wells for sensors installed in piping system
 - 4. Flow Meters

PART 3 – EXECUTION

3.1 COORDINATION

- A. Coordinate with the Building Management and Control System (BMCS) Contractor.
 - 1. Provide project-scheduling information to the BMCS Contractor to allow ample time for purchase of equipment and devices.
 - 2. Schedule periodic project meetings to review progress and coordination issues.
 - 3. Submit a written report, to the Architect/Engineer, on a monthly basis stating status of coordination effort.
- B. The BMCS contractor will submit shop drawings to this contractor for review and coordination processing.

3.2 INSTALLATION

- A. This Contractor will be responsible for the following:
 - 1. Installation of control valves for HVAC equipment.
 - 2. Installation of dampers for HVAC equipment.
 - 3. Installation of temperature sensor wells in piping.
 - 4. Installation of pressure taps in piping system.
 - 5. Installation of flow meter taps in piping system.
- B. Install the above material under the direction of the Building Management and Control System (BMCS) Contractor.

END OF SECTION

SECTION 23 20 00 - HVAC PIPE AND PIPE FITTINGS - GENERAL

PART 1 – GENERAL

1.1 WORK INCLUDED

- A. Furnish and install pipe and pipe fittings for piping systems specified in Division 23 - Mechanical.

1.2 RELATED WORK

- A. Division 23 Mechanical:
 - 1. Earthwork.
 - 2. Valves, Strainers and Vents.
 - 3. Vibration Isolation.
 - 4. Insulation.
 - 5. Other Piping Sections

PART 2 – PRODUCTS

2.1 PIPE AND FITTINGS

- A. The particular type of pipe and fittings for each system is specified in the individual sections.

2.2 JOINTS

- A. Make screwed joints using machine cut USASI taper pipe threads. Apply a suitable joint compound to the male threads only. Ream the pipe to full inside diameter after cutting. All-thread nipples are not permitted.
- B. Dissimilar Metals. Make joints between copper and steel pipe and equipment using insulating unions or couplings such as Crane Company #1259; EPCO as manufactured by EPCO Sales, Inc.; or an approved equal.
- C. Solder joints.
 - 1. Prior to making joints, cut pipe square and ream to full inside diameter. Clean exterior of pipe and socket. Apply a thin coat of suitable fluxing compound to both pipe and socket, and fit parts together immediately.
 - 2. Heat assembled joint only as required to cause the solder to flow. Run the joint full, slightly beaded on the outside, and wipe to remove excess solder.
 - 3. Use silver brazing alloy or Sil-Fos on refrigerant piping and on underground piping. Use lead free solder on all other copper piping.
- D. Make welded joints as recommended by the standards of the American Welding Society. Ensure complete penetration of deposited metal with base metal. Provide filler metal suitable for use with base metal. Keep inside of fittings free from globules of weld metal. The use of mitered joints is not approved.
- E. Flanged.
 - 1. Prior to installation of bolts, center and align flanged joints to prevent mechanical pre-stressing of flanges, pipe or equipment. Align bolt holes to straddle the vertical, horizontal or north-south centerline. Do not exceed 3/64" per foot inclination of the flange face from true alignment.
 - 2. Use flat-face companion flanges only with flat-faced fittings, valves or equipment. Otherwise, use raised-face flanges.

3. Install gaskets suitable for the intended service and factory cut to proper dimensions. Secure with manufacturers recommended gasket cement.
 4. Use ANSI nuts and bolts, galvanized or black to match flange material. Use ANSI 316 stainless steel nuts and bolts underground. Tighten bolts progressively to prevent unbalanced stress. Draw bolts tight to ensure proper seating of gaskets.
 5. Use carbon steel flanges conforming to ANSI B16.5 with pipe materials conforming to ASTM A 105 Grade II or ASTM A 108, Grade II, ASTM A 53, Grade B. Use slip-on type flanges on pipe only. Use welding neck type flanges on all fittings. Weld slip-on flanges inside and outside.
 6. Keep flange covers on equipment while fabricating piping. Remove when ready to install in system.
- F. Mechanical Joints: Provide a stuffing box type mechanical joint adapted to use gasket, cast iron gland and bolts. Coat bolts with bitumastic enamel. Use joint parts similar in design to one of the following:
1. Doublex Simplex Joint manufactured by the American Cast Iron Pipe Company, Birmingham, Alabama.
 2. U.S. joints manufactured by the United States Pipe and Foundry Company, Burlington, New Jersey.
 3. Boltite Joint manufactured by the McWane Cast Iron Pipe Company, Birmingham, Alabama.
 4. Flexlamp manufactured by the National Cast Iron Pipe Company, Birmingham, Alabama.

2.3 UNIONS

- A. Use 150 lb. standard (300 lb. WOG) malleable iron, ground joint unions with bronze seat. Provide flanged joints on piping 2-1/2" and larger.
1. Where pipe material of different types join, use a dielectric union. Union shall be threaded, solder or as required for its intended use.

2.4 BRANCH CONNECTIONS

- A. Pipe 2" and Smaller: For threaded piping, use straight size reducing tee. When branch is smaller than header, a nipple and reducing coupling or swagged nipple may be used.
- B. 2-1/2" through 36": For welding piping, when branch size is the same as header size, use welding tee. For threaded branch connections, use 3000 lb. full coupling or Thread-o-let welded to header.

2.5 GASKETS

- A. High Temperature Piping: Provide 1/16" thick ring gaskets of aramid reinforced SBR such as Garlock #3200 or 3400 or equal by Advanced Products and Systems.
- B. Other Piping: Provide ring rubber gaskets, Garlock #7992 or equal by Advanced Products and Systems. Use 1/8" thick cloth reinforced neoprene gaskets. For smaller than 6", use 1/16" thick gasket.

2.6 FLOORS AND CEILING PLATES

- A. 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.

2.7 DOMESTIC MANUFACTURE

- A. All piping material, pipe and pipe fittings shall be manufactured in the United States of America.

PART 3 – EXECUTION

3.1 PIPE FABRICATION AND INSTALLATION

- A. Make piping layout and installation in the most advantageous manner possible with respect to headroom, valve access, opening and equipment clearance, and clearance for other work. Give particular attention to piping in the vicinity of equipment. Preserve the required minimum access clearances to various equipment parts, as recommended by the equipment manufacturer, for maintenance.
- B. Cut all pipes to measurement determined at the site. After cutting pipe, remove burrs by reaming. Bevel plain ends of ferrous pipe.
- C. Install piping neatly, free from unnecessary traps and pockets. Work into place without springing or forcing. Use fittings to make changes in direction. Field bending and mitering is prohibited. Make connections to equipment using flanged joints, unions or couplings. Make reducing connections with reducing fittings only.
- D. Install piping without tapping out of the bottom of pipe.

3.2 WELD

- A. Weld and fabricate piping in accordance with ANSI Standard B31.1, latest edition, Code for Pressure Piping.
- B. Align piping and equipment so that no part is offset more than 1/16". Set fittings and joints square and true, and preserve alignment during welding operation. Use of alignment rods inside pipe is prohibited.
- C. Do not permit any weld to project within the pipe so as to restrict flows. Tack welds, if used, must be of the same material and made by the same procedure as the completed weld. Otherwise, remove tack welds during welding operation.
- D. Do not split, bend, flatten or otherwise damage piping before, during or after installation.
- E. Remove dirt, scale and other foreign matter from inside piping before tying into existing piping sections, fittings, valves or equipment.
- F. Bevel ends of ferrous pipe.

3.3 OFFSETS AND FITTINGS

- A. Due to the small scale of drawings, the indication of offsets and fittings is not possible. Investigate the structural and finish conditions affecting the work and take steps required to meet these conditions.
- B. Install pipe close to walls, ceilings and columns so pipe will occupy minimum space. Provide proper spacing for insulation coverings, removal of pipe, special clearances, and offsets and fittings.

3.4 SECURING AND SUPPORTING

- A. Support piping to maintain line and grade, with provision for expansion and contraction. Use approved clevis-type or trapeze-type hangers connected to structural members of the building. Single pipe runs to be supported by approved clevis type hangers. Multiple pipe runs to be supported by approved trapeze type hangers. Do not support piping from other piping or structural joist bridging. Review structural drawings for additional information.
- B. Provide supports both sides and within 12" of each horizontal elbow for pipe 6" and larger.
- C. Support vertical risers with steel strap pipe clamps of approved design and size, supported at each floor. Support piping assemblies in chases so they are rigid and self-supported before the chase is closed. Provide structural support for piping penetrating chase walls to fixtures. On chilled water pipe supports shall be outside the insulation.
- D. Where insulation occurs, design hangers to protect insulation from damage. Pipe saddles and insulation shields, where required, are specified in the appropriate insulation section and are sized in accordance with the schedule on the drawings.
- E. Install trapeze hangers, properly sized, to support the intended load without distortion. Use hangers with 1-1/2" minimum vertical adjustment.
- F. Use electro-galvanized or zinc plated beam clamps if acceptable to the structural engineer, threaded rods, nuts, washers and hangers. All hanger rods shall be trimmed neatly so that no more than 1 inch of excess hanger rod protrudes beyond the hanger nut. Use only on beams as directed by the Structural Engineer.
- G. At outdoor locations, all supports, brackets and structural members shall be hot-dipped galvanized.
- H. Provide hangers within 3' of pipe length from all coil connections.
- I. Support spacing: As recommended by the project structural engineer and support manufacturer, but not more than listed below. Not to exceed spacing requirements of smallest pipe.

| Pipe Size | Copper & Steel Max. Support Spacing, Ft. | Cast Iron Max. Support Spacing, Ft. | Minimum Rod Diameter, Inches |
|-----------------|--|-------------------------------------|------------------------------|
| 1" & smaller | 6 | | 3/8 |
| 1-1/4" & 1-1/2" | 8 | 5 | 3/8 |
| 2" | 10 | 5 | 3/8 |
| 3" | 10 | 5 | 1/2 |
| 4" & 5" | 10 | 5 | 5/8 |
| 6" and above | 10 | 5 | 3/4 |

3.5 PIPE SUPPORTS

- A. Provide P1001 or P 5000 Unistrut metal framing members and appurtenances for pipe support. Hot-dip galvanized members and appurtenances when located outside. Sagging of pipes or supports is not acceptable.
- B. Adjustable clevis hangers shall be used for single pipe supports; Anvil Fig. 260. When oversized clevis is used, a nipple shall be placed over the clevis bolt as a spacer to assure that the lower U-strap will not move in on the bolt. Provide adjustable clevis with a nut / washer above and below the hanger on the support rod. Ring type clevis hangers are not acceptable.

- C. Provide Anvil Figure 45 galvanized or primed and painted channel assembly for trapeze hangers.

3.6 PIPE SUPPORTS ON ROOF

- A. Support condensate drain pipe on roof with Portable Pipe Hanger Model PP-10 with roller and fully adjustable height throughout pipe run. Base material shall be high density / high impact polypropylene with UV inhibitors and anti-oxidants. Provide with hot dip galvanized rod finish and framing. Nuts and washers shall be hot dip galvanized.

3.7 PIPE STANDS

- A. Refer to Pipe Stand detail included in drawings for additional information.
- B. All ground mounted pipe stands shall be steel construction and hot dipped galvanized after fabrication.
- C. All pipe stand bases shall be anchored, leveled and grouted to ensure equal weight distribution.

3.8 ANCHORS

- A. Provide anchors as required. Use pipe anchors consisting of heavy steel collars with lugs and bolts for clamping to pipe and attaching anchor braces. Install anchor braces in the most effective manner to secure desired results. Do not install supports, anchors or similar devices where they will damage construction during installation or because of the weight or the expansion of the pipe. When possible, install sleeves in structural concrete prior to pouring of concrete.

3.9 FLOOR PENETRATIONS

- A. At locations where pipe passes through floors, provide watertight concrete curb around penetration.

3.10 PIPE SLEEVES

- A. Sleeves through masonry and concrete construction:
 - 1. Fabricate sleeves of Schedule 40 galvanized steel pipe.
 - 2. Size sleeve large enough to allow for movement due to expansion and to provide continuous insulation.
- B. Sleeves through gypsum wall construction.
 - 1. Fabricate sleeves of 16 gauge galvanized sheet metal.
- C. Sleeves through elevated slab construction.
 - 1. Fabricate sleeves of Schedule 40 galvanized steel pipe with welded center flange in floor.
- D. Extend each sleeve through the floor or wall. Cut the sleeve flush with each wall surface. Sleeves through floors shall extend 2" above floor lines for waterproofing purposes. Slab on grade floors shall not be sleeved except where penetrating waterproofing membrane or insect control is required.
- E. Caulk sleeves water and air tight. Seal annular space between pipes and sleeves with mastic compound to make the space water and air tight.

- F. For sleeves below grades in outside walls, provide Thunderline Link-Seal or Advance Product and System Interlynx, with 316 stainless steel nuts and bolts, with cast iron pressure plate.
- G. Provide chrome plated escutcheon plates on pipes passing through walls, floors or ceilings exposed to view. At exterior walls, stainless steel sheet metal is to be used.
- H. For sleeves through fire and smoke rated walls, seal with a UL through-penetration firestop, rated to maintain the integrity of the time rated construction. Install in accordance with the manufacturer's installation instructions. Comply with UL and NFPA standards for the installation of firestops. Refer to Architectural drawings for all fire and smoke rated partitions, walls, floors, etc.

3.11 ISOLATION VALVES

- A. Provide piping systems with line size shutoff valves located at the risers, at main branch connections to mains for equipment, to isolate central plant, and at other locations.

3.12 DRAIN VALVES

- A. Install drain valves at low points of water piping systems so that these systems can be entirely drained. Install a line size drain valve for pipes smaller than 2" unless indicated otherwise. For pipes 2-1/2" and larger, provide 2" drain valves unless indicated otherwise. Drain valves shall be plugged when not in use and at completion.

3.13 CLEANING OF PIPING SYSTEMS

- A. 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. Flush the chilled and hot water systems utilizing the filter feeders.
- B. 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 strainers, remove and clean as frequently as necessary.
- C. Phase One: Initial flushing of system. Remove loose dirt, mill scale, weld beads, rust and other deleterious substances 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.
- D. 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.
- E. Dispose of water in approved manner.
- F. Phase Two: Cleaning of Piping Systems. Remove, without chemical or mechanical damage to any system component, adherent dirt (organic soil), oil, grease, (hydrocarbons), welding and soldering flux, mill varnish, piping compounds, rust (iron oxide) and other deleterious substances not removed by initial flushing. Chemical shall be equal to Nalco 2578 prepping compound. Insert anti-foam compound as necessary. Circulate for 48 hours or as recommended by the manufacture. Dispose of water in approved manner. Flush system and replace with clean water. Verify compatibility of

chemicals used with existing chemical treatment program on remodel projects.

- G. Phase Three: Final flushing and rinsing: 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.
- H. Submit status reports upon completion of each phase of work on each system.
- I. Special requirements, if any, are specified in the sections on each type of piping or in the section on Water Treatment Systems.

3.14 TESTING

- A. Test piping after installation with water hydrostatic pressure of 1-1/2 times operating pressure (150 psig minimum) and carefully check for leaks. Repair leaks and retest system until proven watertight.
- B. Do not insulate or conceal piping systems until tests are satisfactorily complete.
- C. If any leaks or other defects are observed, suspend the test and correct the condition at once. Repeat testing until leaks are eliminated and the full test period is achieved.
- D. The satisfactory completion of testing does not relieve the Contractor of responsibility for ultimate proper and satisfactory operation of piping systems and their accessories.

3.15 PIPE MARKERS

- A. Identify interior exposed piping and piping in accessible chases or plenums with Opti-Code Brady Pressure Sensitive Adhesive Pipe Markers, consisting of pipe marker and direction of flow arrow tape. Clean pipe prior to installation. Background colors of markers, arrows and tape for each type of system shall be the same. Meet ANSI/OSHA standards and clearly identify each system. Provide minimum 2-1/4-inch letters through 4-inch pipe and 4-inch letters for 5-inch pipe and larger.
- B. Identify exterior and mechanical room piping with Snap Around pipe markers through 4-inch pipe and Strap Around markers 5-inch pipe and larger. Pipe markers consisting of pipe marker and direction of flow arrow tape; background colors of markers, arrows and type for each type of system shall be the same. Meet ANSI / OSHA standards and clearly identify each system. Provide minimum 2-1/4-inch letters through 4-inch pipe and 4-inch letters for 5-inch pipe and larger.
- C. Install identification in the following locations:
 - 1. both sides of penetrations through walls, floors and ceilings.
 - 2. Close to valves or flanges.
 - 3. Intervals on straight pipe runs not to exceed 50 feet
 - 4. Apply marker where view is obstructed.
- D. Pipe markers shall meet or exceed the specifications of the ASME A13.1 "Scheme for Identification of Piping Systems".

END OF SECTION

**SECTION 23 21 13 - HOT WATER AND CHILLED WATER PIPING,
VALVES AND APPURTENANCES**

PART 1 – GENERAL

1.1 WORK INCLUDED

- A. Furnish and install heating water and chilled water piping, valves and appurtenances, including fittings and strainers. Domestic hot water piping is specified in the Domestic Water Piping and Appurtenances section.

1.2 RELATED WORK

- A. Division 23 Mechanical:
 - 1. Pipe and Pipe Fittings - General
 - 2. Valves, Strainers and Vents
 - 3. Vibration Isolation
 - 4. Insulation

PART 2 – PRODUCTS

2.1 PIPE AND FITTINGS

- A. For pipe 2" and less in diameter, provide pipe conforming to ASTM A 53, Grade A or B, or ASTM A106 schedule 80 seamless, or electric-resistance welded black steel pipe. Furnish 150 lb. screwed malleable iron fittings conforming to ANSI B 16.3 for chilled water. Provide fittings conforming to ANSI B 16.4 for hot water.
- B. For pipe 2-1/2" in diameter and larger, provide pipe meeting the requirements of ASTM A 53, Grade A or B, or ASTM A 106 schedule 80 seamless, or electric-resistance welded black steel pipe with standard weight seamless steel welded fittings, satisfying ASTM A 234, Grade WPA or WPB, ANSI B16.9.

2.2 VALVES

- A. Refer to Section 23 05 23.
- B. Refer to Building Management and Control System.

2.3 WATER SPECIALTIES

- A. Pressurized Expansion Tanks shall be precharged steel tank with a replaceable heavy duty Butyl rubber bladder. The tank shall have a 1-1/2" system connection, drain, and a standard tire valve to facilitate on-site charging of the tank. The tank shall be fitted with lifting rings and a floor mounting skirt for vertical installation. The tank must be constructed in accordance with Section VIII of ASME Boiler and Pressure Vessel Code and stamped 125 PSI working pressure.
 - 1. Acceptable manufacturers: Bell & Gossett, Taco, Wessels, John Wood Company, and Wheatley.
- B. Pressure Reducing Valves shall be diaphragm operated with brass body, low inlet pressure check valve and inlet strainer. The strainer shall be easily removed without system shutdown. The valve seat, strainer, and stem must be removable and of non-corrosive material.
 - 1. Acceptable Manufacturers: Bell & Gossett, Armstrong, Taco, and Wheatley.
- C. Automatic Air vents shall be float actuated high capacity air vent designed to purge free air from the system and provide shutoff at pressures up to 150 psig at a maximum temperature of 250 degrees F. The design of the high capacity air vent shall prevent air from entering the system if system pressure should drop below atmospheric pressure.

The high capacity air vent shall purge free air at pressures up to 150 psig during normal system operation. The high capacity air vent shall be constructed of cast iron and fitted with components of stainless steel, brass, and EPDM.

1. Acceptable Manufacturers: Bell & Gossett, Armstrong, Taco, and Wheatley.

- D. Air and Dirt Separators shall be a full flow coalescing type combination air eliminator and dirt separator. The separator shall be designed for full flow high volume systems. The inlet and outlet connections shall be the same as adjoining pipe. Vessel shall be fabricated steel, rated for 150 psig working pressure, stamped and registered in accordance with ASME Section VIII, Division 1 for unfired pressure vessels, and include two equal chambers above and below the inlet and outlet nozzles. The vessel shall include copper or stainless steel coalescing medium to aid in the separation of air and dirt in the system entrained water. Air elimination efficiency shall be 100% free air, 100% entrained air, and a minimum of 99.6% dissolved air at the installed location. Dirt separation efficiency shall be a minimum of 80% of all particles 30 micron and larger within 100 passes. Unit shall be provided with a separate venting chamber to prevent system contaminants from harming the float and venting valve operation. Unit shall be provided with all options to allow for ground mounting and support from bottom of separator.

1. Acceptable manufacturer shall be Spirovent Series HD by Spirotherm, TACO 4900, Thrush Standard Velocity.

PART 3 – EXECUTION

3.1 TESTING

- A. Test all piping systems to assure they are absolutely leak free.
- B. Apply a hydraulic pressure 1-1/2 times the operating pressure, 150 psig minimum, and check for leaks. Maintain test for a minimum of 24 hours. The piping system must remain absolutely tight during this period. The satisfactory completion of any test or series of tests will not relieve the contractor of responsibility for ultimate proper and satisfactory operation of piping systems and their accessories. The test should be observed by the Architect / Engineer before pressure is removed and water drained.

3.2 AIR HANDLING UNIT PIPING

- A. Provide a minimum of 12" of straight pipe at all coil piping connections.

3.3 AIR SEPARATOR

- A. Install full size drain to nearest floor drain.
- B. Install air vent drain to nearest floor drain.

END OF SECTION

SECTION 23 21 23 - HVAC PUMPS

PART 1 – GENERAL

1.1 WORK INCLUDED

- A. General characteristics for pumps specified in Division 23 - Mechanical.

1.2 RELATED WORK

Requirements for pumps are specified in other sections of Division 23 - Mechanical, including the following:

- A. Division 23 Mechanical - Electrical Provisions of Mechanical Work.

1.3 PUMP SELECTION

- A. Select pumps conservatively for scheduled conditions. Furnish pumps that have reasonably high efficiencies, with peak efficiency at or near rated conditions. Select pumps that will operate stably at 15' suction lift despite substantial reduction in head or substantial increase in delivery.
- B. If the pumps proposed are not considered suitable, submit manufacturer's data on other pumps, for review.
- C. Scheduled design flow, design head, pump efficiency, and motor horsepower are the minimum acceptable.
- D. The pump curve shall rise continuously from maximum flow to cut-off.
- E. Shut-off head approximately 10 percent greater than design head, unless otherwise indicated in pump schedules.
- F. Pump brake horsepower shall not exceed the motor horsepower rating over the entire operating range from shut-off to run-out.
- G. Select the pump for operation at or near peak efficiency.
- H. Cavitation-free at all points on the curve.
- I. Impeller diameter shall not exceed 90 percent of the maximum published diameter.
- J. Pumps shall be suitable for parallel operation. Where pumps are operated in parallel, individual pumps shall be capable of stable operation with only one pump operating in the system. Submit pump curves with single and multiple pumps operating on system curve for approval.

1.4 PUMP SIZE AND TYPE

- A. Provide motor-driven pumps of the type and speed scheduled. Select pumps that are not overloaded throughout the entire range of pump operation. Provide pump connection sizes as indicated.
- B. The head capacities indicated in the schedules are listed for bidding purposes only. Calculate the operating head at each pump; take into consideration the actual routing of the various lines, pressure drops in heat exchangers and coils, exact lengths of pipe,

fittings, etc. Submit these calculations, together with copies of manufacturer's performance curves, as shop drawings on each pump. Clearly mark the curves for each pump to indicate the diameter of the impeller and the selection point.

1.5 CERTIFIED DATA

- A. Submit factory certified pump curves showing pump performance characteristics with pump and system operating points plotted. Curves shall include as a minimum, flow (gallons per minute), head (feet of water), all available impeller diameters (inches), efficiency (percent), net positive suction head required (feet of water), brake horsepower, pump size and pump model. When multiple pumps are operating in parallel, show pump curves for one pump running, two pumps running, and so on. Show pump curves with system curve plotted.

PART 2 – PRODUCTS

2.1 VERTICAL IN-LINE (VIL) PUMPS

- A. Pump Construction:
1. Pump casing, cast iron with 125 psig ANSI/PN16 flanges for working pressure below 175 psig at 150°F and ductile iron with 250 psig ANSI / PN25 flanges for working pressure to 375 psig at 150°F.
 2. Suction and discharge connections shall be flanged and the same size and shall be drilled and tapped for seal flush and gauge connections.
 3. Impeller: Bronze, fully enclosed type; dynamically balanced, two-plan balancing is required where installed impeller diameter is less than 6 times the impeller width.
 4. Shaft: Provide 316 stainless steel pump shaft.
 5. Coupling: Rigid spacer type of high tensile aluminum alloy. Coupling is to be designed to be easily removed on site to reveal a space between the pump and motor shafts sufficient to remove all mechanical seal components for servicing and to be replaced without disturbing the pump or motor.
 6. Mechanical seals shall be stainless steel multi-spring inside or outside balanced type with Viton secondary seal, carbon rotating face and silicon carbide stationary seat. Provide 316 stainless steel gland plate. Provide factory installed flush line with manual vent.
 7. Split coupled pumps shall be provided with a lower seal chamber throttle bushing to ensure seals maintain positive cooling and lubrication.
 8. Provide seal flush supply line to the mechanical seal with a 50 micron cartridge filter and sight flow indicator to suit the working pressure encountered. Filters shall be changed by the installing contractor after system is flushed and on a regular basis until turned over to the Owner.
 9. Supply in the flush line to the mechanical seal a maintenance free sediment separator with sight flow indicator.
 10. Natatorium pumps shall utilize a cast 316 stainless steel impeller and a ductile iron casing with fusion bonded epoxy coating to withstand corrosion caused by chlorinated water.
- B. Single stage, single or double suction type, with pump characteristics which provide rising heads to shut off. Refer to pump schedule for pump flows and heads and motor speed, enclosure, efficiency and power requirements and other system conditions.
- C. Pump Motor:
1. Premium efficiency
 2. Totally enclosed fan cooled
 3. Cast iron frame and end plate

4. (2) Forge steel lifting eye
5. Over-sized conduit box with ground lug
6. So sized with relation to the pump impeller that the brake horsepower requirements will not overload the motor at any point on the pump curve.
7. Critical speed of the pump shall be at minimum 115% of the operating speed listed in the pump schedule.
8. Designed for Variable Frequency Drive Application
9. Greaseable bearings rated for a minimum of 200,000 hours.
10. Minimum Efficiency

| | | |
|--------|----------|-------|
| 3 hp | 1800 rpm | 89.5% |
| 5 hp | 1800 rpm | 90.2% |
| 7.5 hp | 1800 rpm | 91.7% |
| 10 hp | 1800 rpm | 91.7% |
| 15 hp | 1800 rpm | 92.4% |
| 20 hp | 1800 rpm | 93% |
| 25 hp | 1800 rpm | 93.6% |
| 30 hp | 1800 rpm | 94.1% |
| 40 hp | 1800 rpm | 94.5% |
| 50 hp | 1800 rpm | 94.5% |
| 60 hp | 1800 rpm | 95% |
| 75 hp+ | 1800 rpm | 95.4% |

D. Data plates:

1. Provide the pump with a nameplate constructed of 300 series stainless steel securely fastened to pump casing with stainless steel pins.
2. Locate the nameplate for easy visibility.
3. Clearly stamp the rating conditions and other data below, as a minimum, on the nameplate.
 - a. Manufacturer, address, telephone number
 - b. Pump model number
 - c. Pump serial number
 - d. Size (including impeller diameter scheduled in inches)
 - e. Type
 - f. Equipment designation as listed on the pump schedule.
 - g. Flow scheduled (gallons per minute)
 - h. Dynamic head scheduled (feet of water)
 - i. Efficiency (percent)
 - j. Shut-off head (feet of water)
 - k. Speed (rpm)
 - l. Brake horsepower
 - m. Maximum brake horsepower with rated impeller
 - n. Rotation
 - o. Maximum allowable pressure (psig)

E. The schedule on the drawing sets forth the type of pump and GPM required.

1. The head capacities and horsepower are for bidding purposes only.
2. Make pump selection based on actual system calculations.

F. Acceptable manufacturers:

1. Bell & Gossett
2. Armstrong Series 4300
3. Aurora
4. Taco
5. Grundfos
6. Patterson

2.2 VERTICAL TURBINE CONDENSER WATER PUMP

- A. Pump Construction:
1. Pump bowls shall be flanged and bolted, made of cast iron. Flanges shall be of sufficient cross-section to prevent deflection.
 2. Impellers shall be bronze enclosed type, secured to the shaft with steel tapered collets.
 3. Pump bowls shall be provided with replaceable bronze wear rings.
 4. Pump shaft shall be of stainless steel, rolled or forged, ground and sized to provide minimum deflection.
 5. Belled suction of cast iron.
- B. Bearings:
1. Bronze sleeve bearings shall be provided in each bowl and in the suction bell.
 2. Bowl bearings shall be lubricated by the pumped liquid.
 3. Suction bell bearing shall be packed permanently with non-soluble grease and fitted with a bronze sand collar with a 200,000 hour minimum rating.
- C. Column Assembly:
1. Discharge column pipe for 10" pumps and larger shall be steel with flanged connections.
 2. Discharge column pipe for 8" pumps and smaller shall be with flanged or threaded connections.
 3. Line shafting shall be steel, rolled or forged and ground. Shaft sections shall be connected through steel threaded couplings. Minimum shaft size is 1".
 4. Provide water lubricated cutless rubber bearings with bronze retainers at each column connection.
- D. Surface Discharge Head Assembly:
1. Above-ground mounting of close-grained cast iron with an integral discharge flange. Flange shall be 150 lb. ANSI flat face type.
 2. The discharge head base shall be of sufficient size and shall conform to ANSI flange drilling as required to span an opening of dimensions that shall permit removal of the complete pump unit connected below.
 3. Provide two lifting lugs with capacity to support the weight of the entire pump.
- E. Provide each pump with packing material stuffing box.
1. Cast iron stuffing box and stainless steel gland bolts.
 2. Bronze seal box bearing
 3. John Crane 1345
- F. Pump shall be provided with a basket type suction strainer of bronze or stainless steel. The net open area of the strainer shall be at least twice the area at the suction bell lip.
- G. Pump motor:
1. Vertical direct connected.
 2. Constant speed.
 3. Premium Efficiency TEFC suitable for use outdoors.
 4. 90% efficiency at loads of 75% through 100%.
 5. So sized with relation to the pump impeller that the brake horsepower requirement will not overload the motor at any point on the pump curve.
 6. Non-reverse ratchet
 7. Provide motor internal heater for prevention of condensation.
- H. Data plates:

1. Provide the pump with a nameplate constructed of 300 series stainless steel securely fastened to pump casing with stainless steel pins.
2. Locate the nameplate for easy visibility.
3. Clearly stamp the rating conditions and other data below, as a minimum, on the nameplate.
 - a. Manufacturer, address, telephone number
 - b. Pump model number
 - c. Pump serial number
 - d. Size (including impeller diameter scheduled in inches)
 - e. Type
 - f. Equipment designation as listed on the pump schedule.
 - g. Flow scheduled (gallons per minute)
 - h. Dynamic head scheduled (feet of water)
 - i. Efficiency (percent)
 - j. Shut-off head (feet of water)
 - k. Speed (rpm)
 - l. Brake horsepower
 - m. Maximum brake horsepower with rated impeller
 - n. Rotation
 - o. Maximum allowable pressure (psig)
- I. The schedule on the drawing sets forth the type of pump and GPM required.
 1. The head capacities and horsepower are for bidding purposes only.
 2. Make pump selection based on actual system calculations.
- J. Acceptable Manufacturers:
 1. Peabody Flo-way
 2. Peerless
 3. Taco
 4. Patterson

2.4 FLOW INDICATOR

- A. Flow Indicator:
 1. Bronze Construction
 2. Rotating wheel
 3. Line Size
 4. Double Window
 5. Ernst Flow Industries Model EFI E-57-3

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install the pumps in accordance with Manufacturer's "Installation, Start-up and Service Instructions".
 1. Provide a minimum of 24" access space around pumps for service.
 2. Install pumps on concrete housekeeping base, with anchor bolts, set and level, and grout in place. Install stainless steel drain pan with trough under chilled water pumps only.
 3. Provide air cock and drain connection piped to floor drain.
 4. Lubricate pumps prior to start-up.
 5. Install condenser water pumps to ensure a full flooded suction.
 6. Paint entire unit with two coats of machinery enamel after completion of installation.
 7. Provide a spool piece between the suction diffuser and the suction side of the

8. pump minimum length 8" face to face.
 9. Provide pressure taps with valves on each side of the pump.
 10. Install hot water circulator horizontally, properly supported to wall, in an accessible location for testing and maintenance at a height not to exceed 60" above finished floor. Install line size Ernst bronze rotating wheel, flow indicator with double window, downstream of circulator.
 10. Reference section 23 05 13 Article 3.1 paragraph D for motor wiring connectors.
- B. Provide a line size isolation valve and strainer on the pump suction and a line size silent check valve and balancing valve on the pump discharge. Provide an automatic air vent off the pump casing. For base mounted pumps, provide a drain line the full size of the base connection and extend it to and terminate it over the nearest floor drain.
- C. Support piping adjacent to the pump such that no weight is carried on the pump casing. Decrease from pipe size with eccentric reducer on suction side and concentric increaser on discharge side.
- D. Ensure pumps:
1. Operate at specified system fluid temperatures without vapor binding and cavitation.
 2. Are non-overloading in parallel and individual operation.
 3. Operate within 25 percent of midpoint of published maximum efficiency curve.
- E. Refer to pump detail on the Contract Drawings for piping accessories to be provided.

3.2 MANUFACTURER START-UP SERVICE ALIGNMENT

- A. After installation, the pumps and motors are to be aligned by the manufacturer or their representative utilizing a dial indicator. After completion, a formal report must be submitted by the Manufacturer to the Engineer prior to final acceptance. This report must include pump serial number, location, beginning and final alignment at a minimum.
1. Technicians, as required, shall be trained and experienced in the work they perform (contractor start-up / alignment is unacceptable).
- B. Before starting pumps, but after connecting piping:
1. Align shafts and coupling with a precision dial indicator alignment instrument to the minimum tolerances .004 (TIR) per inch of coupling radius or as recommended by the manufacturer, whichever is the greater.
 2. Tabulate the actual pump alignment reading with manufacturer's minimum tolerances.
 3. Submit readings for approval.
 4. Include the approved readings in the Owner's Maintenance Manual.

3.3 FINAL PUMP FLOW CALIBRATION

- A. Based on the results of the final phases of the test and balance sequences, if the flow of the unthrottled pump is more than 10% above the scheduled values:
1. Request detailed instructions from the pump manufacturer for the correct impeller diameter.
 2. Trim the impeller to the diameter recommended by the manufacturer, employing precision machinery.
- B. Enter the information on the final configuration of the pump in the Owner's Manual.
1. Modify the pump nameplate to reflect the correct head and flow data and the impeller diameter.

3.4 SPARE PARTS

- A. Provide the following spare parts and material to the Owner for his use after the warranty period.
1. An extra packing box rebuild kit and 5 packing rings for each condenser water pump.
 2. An extra mechanical seal for each vertical inline pump.
 3. A set of bearings for each horizontal pump.

END OF SECTION

SECTION 23 21 24 - CONDENSER WATER PIPING, VALVES AND APPURTENANCES

PART 1 - GENERAL

1.1 RELATED WORK

- A. Division 23 Mechanical
 - 1. Pipe and Pipe Fittings - General
 - 2. Valves, Strainer and Vents
 - 3. Vibration Isolation
 - 4. Painting

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

- A. Aboveground.
 - 1. 2" or smaller diameter pipe: Provide ASTM A #53 Grade A or B or ASTM A 120, Sch. 40 seamless or electric-resistance welded black steel pipe with 150 lb. screwed malleable iron fittings, ANSI B16.3.
 - 2. 2-1/2" through 6" pipe: Provide ASTM A #53 Grade A or B or ASTM A 120, Sch. 40 seamless or electric-resistance welded black steel pipe with standard weight seamless steel welding fittings, ASTM A 234, Grade WPA or WPB, ANSI B16.9.
 - 3. 8" through 20" pipe: Furnish ASTM A 53, Grade A or B, Sch. 20, seamless or electric-resistance welded black steel pipe with standard weight seamless steel welding fittings, ASTM A 234, Grade WPA or WPB, ANSI B16.9.
 - 4. 24" and larger diameter pipe: ASTM A 53, Grade A or B, 0.375" wall seamless or electric-resistance welded black steel pipe with seamless steel welding fittings, 0.375" wall, ASTM A 234, Grade WPA or WPB, ANSI B16.9. At Contractor's option, pipe sizes over 24" outside diameter can be ASTM A 134 with mitered fittings using ASTM A 285, Grade B or C steel plate.
- B. Exterior Above Grade:
 - 1. Galvanized steel pipe, Schedule 40
 - 2. Fitting: Grooved

2.2 VALVES

- A. Refer to Section 23 05 23.
- B. Refer to Building Management and Control System.

PART 3 - EXECUTION

3.1 TESTING

- A. Apply a hydraulic pressure of 1-1/2 times operating pressure, 150 psig minimum, and check for leaks. Maintain test for a minimum of 24 hours. The piping system must remain absolutely tight during this period. The satisfactory completion of any test or series of tests will not relieve the contractor of responsibility for ultimate proper and satisfactory operation of piping systems and their accessories. The test should be observed by the Architect / Engineer before pressure is removed and the water drained.

END OF SECTION

SECTION 23 23 00 - REFRIGERANT PIPING AND APPURTENANCES

PART 1 – GENERAL

1.1 WORK INCLUDED

- A. Furnish and install copper tubing, valves, strainers and sight glass for refrigerant piping.

1.2 RELATED WORK

- A. Division 23 Mechanical.
 - 1. Pipe and Pipe Fittings
 - 2. Piping Insulation

PART 2 – PRODUCTS

2.1 PIPE AND FITTINGS

- A. Furnish refrigerant piping of Type K hard-drawn copper tubing with sweat-type, wrought copper fittings. Cast fittings are not permitted.

2.2 SERVICE VALVES

- A. Provide angle or globe service valves, with sweat connections. Use packed-type, wrench operated, valves with gasketed seal cap and back seat feature. Furnish valves designed for refrigerant service, in conformance with the ARI code.
- B. Place service valves at the inlet and outlet of each compressor, on both sides of each strainer and solenoid valve, and as otherwise shown and specified.

2.3 SOLENOID VALVES

- A. Furnish pilot-operated, floating-piston solenoid valves suitable for operation with refrigerant.
- B. Use valves with a bronze body and sweat-type connections.
- C. Provide stainless steel stem and plunger assembly and a stainless steel piston.
- D. Furnish sealed and moisture proof solenoid coils.
- E. Use electrical characteristics of 115 volt, 60 Hertz.

2.4 SIGHT GLASSES

- A. Provide suitable moisture and liquid sight glass in the liquid line leaving the condenser or receiver.

2.5 FILTER DRYER

- A. Furnish replaceable core liquid line filter dryer.
- B. Provide filter dryer constructed to permit the removal of the core element without removing the filter dryer from the line.

PART 3 – EXECUTION

3.1 BRAZING

- A. During the brazing process, dry nitrogen shall be purged through the tubing to prevent oxides from forming.

3.2 PRESSURE TEST

- A. After refrigeration and piping system items are installed, charge the system with dry nitrogen and test to 450 psig.
 - 1. Test joints with a Halide torch or an electronic leak detector.
 - 2. Repair leaks and retest each system until proved tight.

3.3 EVACUATION AND DRYING

- A. After refrigerant system has been pressure-tested, connect a suitable vacuum pump and evacuate piping system, including lines and equipment.
 - 1. Maintain a vacuum as high as practicable for long enough to evaporate the moisture in the system (at least 48 hours).
 - 2. Check the humidity within the system with a wet bulb indicator, and maintain the vacuum until the wet bulb temperature is reduced to -40°F. After the system has been evacuated and dried, break the vacuum by charging proper refrigerant into the system.

3.4 PIPE SIZE

- A. Pipe shall be routed and sized per condensing unit manufacturer's instructions.

END OF SECTION

SECTION 23 25 13 - CIRCULATING WATER SYSTEM CHEMICAL TREATMENT

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Provide equipment, chemicals and treatment materials for the complete water treatment system.
- B. Determine which chemicals to use from the results of a water sample analysis taken from the building domestic water supply.
- C. Provide water treatment products, holding reservoirs, equipment and labor for testing, cleaning, flushing and dispensing products to achieve the required water quality for each system specified.
 - 1. Closed chilled and hot water systems
 - 2. The cooling tower condenser water system
- D. Entire existing chilled water system shall be fully cleaned and flushed prior to the operation of chillers.
- E. Test all existing closed and open water systems and provide report to Owner and Engineer.

1.2 SERVICE AND SUPPLIES

- A. All work shall be performed by a qualified, full-time, Water Program Manager.
 - 1. Specialist in the field of industrial water treatment.
 - 2. Facilities include water analysis laboratory, development facilities and service department.
- B. Provide a water treatment test set for each system (pH, alkalinity, hardness, chloride) for field use including test equipment and reagents as required for specific use with the treatment products employed.
- C. Where specialized supplementary testing or control equipment is required, provide appropriate items.
- D. Provide a water management and service program for a period of one year beginning at substantial completion. Make routine visits bi-weekly during first two months of operation and monthly during the remainder of the specified period.
- E. Routing Services
 - 1. Check and adjust water treatment system operation.
 - 2. Instruct, train and advise operating personnel.
 - 3. Check efficiency of chemicals and chemical applications.
 - 4. Replenish chemicals and replace expendables.
 - 5. Clean or replace filter in feeder.
- F. Chemically clean the piping system.
- G. Provide a complete laboratory analysis of water samples. Insert in the Owner's manuals.
- H. Provide review of report figures in the field water testing.

1.3 QUALITY ASSURANCE

- A. Acceptable program manager shall have:
 - 1. Research and development facilities.
 - 2. Regional laboratories capable of making water analysis.
 - 3. A service department and qualified technical service representatives located within a reasonable distance of the project site.
 - 4. Service representatives who are registered Engineers or factory-certified technicians with not less than 5 years of water treatment experience with the water treatment system manufacturer.
- B. Ensure that all products, packaging, blow-down or other effluents do not violate local, state, or federal laws or regulations. Use only chemicals that are registered, when required, with the U.S. Department of Agriculture or the U.S. Environmental Protection Agency and that are labeled as required by law.
- C. Provide electrical products that have been tested, listed and labeled by Underwriters Laboratories and comply with the National Electrical Manufacturers Association Standards.

PART 2 - PRODUCTS

A.1 ACCEPTABLE MANUFACTURERS

- A. Nalco Water – Ecolab (Contact Danny Short 832-823-9716, danny.short@ecolab.com)

2.2 CLOSED CHILLED AND HOT WATER SYSTEM

- A. Side stream stainless steel filter feeders in the hot water and chilled water systems:
 - 1. Rated at 40-gpm capacity.
 - 2. Operating conditions: 200 psig and 250°F.
 - 3. Single filter cartridge.
 - 4. Cartridge #:
 - a. NALCO 231-FMPIC405HT
 - b. WATTS #FMPIC405HT
 - 5. Fabricated hot dipped galvanized steel support legs and frame. Refer to detail drawing for requirements.
 - 6. Provide sufficient quantity of filter cartridges for warranty period. Minimum of two additional cartridges provided to owner.
 - 7. Provide (2) two drains for filter housing. (1) clean water drain, (1) dirty water drain.
- B. Acceptable Manufacturers: Side Stream Cartridge Filter Housing
 - 1. NALCO #231-FMJCH40
 - 2. WATTS #FMJCH40
- C. Treatment chemicals:
 - 1. Furnished as a concentrated liquid in 5 gallon pails
 - 2. A corrosion inhibitor of the nitrite-borate type equal to Nalco 2534.
 - 3. Maintained at a nitrite residual of 600 – 800 ppm in chilled loops and 1000-1500 in hot loops.
 - 4. With effective copper and black iron corrosion inhibitors.
 - 5. Form a protective film to prevent corrosion and scale formation.
 - 6. Have colored dye to indicate presence.
 - 7. Compatible with all system elements.

- D. Multiple chemicals used in a common system shall be compatible.

2.3 CONDENSER WATER SYSTEM

- A. Prefabricated Panel Mounted Automatic System consisting of the following for each chiller / cooling tower:
1. 1 each Conductivity controller.
 2. 3 each Chemical feed pumps.
 3. Sample stream piping assembly on high-density polyethylene panel.
 4. Prefabricated panel with stainless steel hardware utilized in securing system components.
 5. System sample stream piping assembly shall be constructed of schedule 80 CPVC, and shall consist of inlet and outlet ball valves, clear Y strainer, sample valve, conductivity electrode, three chemical injection stations and flow switch.
- B. Conductivity Controller:
1. The Controller shall be a microprocessor based, menu driven industrial type conductivity controller.
 2. With relay activated on/off control outputs.
 3. 0-1000 microsiemen control range with displayable a 16 character, backlit LCD display.
 4. Adjustable High/Low alarm points with output relays and 4-20ma output.
 5. The controller shall provide four programmable, non-concurrent operational modes for inhibitor feed using either:
 - a. Feed as % of bleed.
 - b. Feed and bleed with limit timer.
 - c. Percent of time.
 - d. Water meter triggered feed.
 6. The Controller shall provide 2 two independent programmable biocide feed functions programmable in cycle modes of 1 to 4 weeks.
 7. An adjustable pre-bleed function based on time or conductivity and programmable lockout feature shall be provided for each individual biocide feed.
 8. Controller shall be an LMI model DC-4500111A1 or approved equivalent.
- C. Chemical Metering Pumps:
1. Chemical metering pumps shall be positive displacement, Liquifram type pumps.
 2. Output volume shall be adjustable while pumps are in operation from 0 to maximum capacity of 14 Gallons per day.
 3. Adjustment shall be by readily accessible dial knobs, one for changing stroke length and the other for changing stroke frequency.
 4. On-off switch shall be integral with frequency control.
 5. Chemical pumps shall be capable, without a hydraulically backed diaphragm, of injecting chemicals against pressures.
 6. Valves shall be cartridge type and renewable by replacing only the cartridge.
 7. Pump head and fittings shall be of PVDF or CPVC construction.
 8. Chemical pumps shall be LMI Model A141-352SI or approved equivalent.
- D. Water Meter for Cooling Tower Make-Up:
1. Electric Contacting Head Water meter which shall be a multi jet design with bronze body and sealed register sized for required make-up flow.
- E. Blow-Down Assembly:
1. 120V actuator with ball valve. Belimo ball valve model B225VS and actuator model SY1-110.
 2. Pre-fabricated Blow-down with isolation valve and "y"-strainer sized for required blow-down.

PART 3 - EXECUTION

3.1 INSTALLATION/START-UP

- A. In accordance with manufacturer's recommendations.
- B. Anchor the chemical filter feeder to a concrete housekeeping pad using wedge type expansion anchors.
- C. Clean and flush closed loops systems.
 - 1. Clear water flush systems before introducing chemical cleaners.
 - 2. Chemical cleaner shall be introduced into the systems to remove construction related oils, greases, threading compounds, and silt.
 - 3. Chemical Cleaner shall passivate and pre-film pipe system.

3.2 WATER ANALYSIS

- A. The chemical treatment agency shall provide the services of a testing laboratory to perform a site water analysis. As a minimum, conduct the following tests in accordance with ASTM standards and to the satisfaction of the Owner/Architect/Engineer.
 - 1. Silica in water and wastewater.
 - 2. Acidity or alkalinity of water.
 - 3. Iron in water.
 - 4. Hardness of water.
 - 5. Ph of water.
 - 6. Particulate and Dissolved Matter, Solids or Residue in Water.
 - 7. Turbidity in water.
 - 8. Corrosivity of water in absence of heat transfer.
 - 9. Standard practices fore sampling water.
- B. Take water samples in accordance with ASTM.
- C. Prepare a test report in accordance with ASTM for each of the tests conducted.
- D. Submit the test reports to the Architect/Engineer.

3.3 CHEMICAL TREATMENT

- A. The chemical treatment agency shall provide complete services necessary for chemically cleaning and treatment the following systems:
 - 1. Chilled water.
 - 2. Hot water.
- B. The chemical treatment agency shall provide, but not be limited to the following:
 - 1. Equipment and installation.
 - 2. Chemicals.
 - 3. Analytical and testing work.
 - 4. Inspection.
 - 5. Calculations.
 - 6. Assistance to the trade installing the piping.
 - 7. Instruction to Owner.
- C. Determine which chemicals to use from the results of site water analysis. Provide the chemical necessary to achieve the desired water condition.

- D. Examine and supervise flushing and pipe cleaning operations and verify that the systems are clean, free of debris and rust and other construction materials before starting water treatment.
- E. After the piping has been flushed, cleaned, rinsed and charged with chemicals, then start-up and operate the chemical treatment equipment to provide steady, stable characteristics for the systems treated.
- F. During construction, instruct the Contractor in the field piping and wiring of chemical feeding equipment. If such piping and wiring details are not shown on the Contract Drawings, then provide all equipment, piping, wiring, instrumentation and chemicals to provide a complete and operating system without additional cost.
- G. After the chemical treatment is functioning as intended, the chemical treatment agency shall demonstrate to the Architect/Engineer the chemical treatment operation.

3.4 OWNER TRAINING

- A. A chemical treatment agency, in conjunction with the chemical treatment equipment manufacturer's factory representative, shall train the Owner to operate and maintain the chemical treatment system as a whole and in part for each piece of equipment.
- B. Furnish to the Owner a chemical treatment administration manual covering the chemical treatment program for each of the systems treated. The manual shall include, but not be limited to:
 - 1. Name, address and telephone number of the chemical treatment agency and each of the equipment manufacturers.
 - 2. Operation and maintenance manuals.
 - 3. Test reports.
 - 4. Chemical data sheets.
 - 5. A narrative describing the chemical treatment program for each of the systems being treated.

3.5 TESTING AND INSPECTION

- A. After the systems have been accepted, the chemical treatment agency shall visit the site every month during the warranty period.
- B. During each visit:
 - 1. Check and adjust the chemical treatment equipment.
 - 2. Check the chemistry of the treated system to confirm the chemicals are maintaining the system as intended.
 - 3. Advise and instruct the Owner on operational changes made to the chemical treatment program.
 - 4. Take a water sample of each system being chemically treated and have the samples tested by a testing laboratory. Prepare a report for each water sample and submit it to the Owner. Include in the test report the changes that need to be made to the chemical treatment program.
 - 5. Maintain complete records of the treatment program for each system at the project site. Keep the records in a hardbound manual with the building manager. A second copy shall be maintained by the agency for the agency's records.
- C. Routine visits must be coordinated with the Owner.
- D. Send copy of monthly report to Engineer for Verification.

END OF SECTION

SECTION 23 31 13 - DUCTWORK

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Duct construction, support and accessories. Dimensions shown on the drawings are free area dimensions.

1.2 RELATED WORK

- A. Division 23 Mechanical
 1. Air Devices
 2. Air Handling Units
 3. Insulation
 4. Terminal Units
 5. Fan Coil Units
 6. Fans
 7. Testing, Balancing and Adjusting (TAB) of Environmental Systems
- B. Division 9 – Finishes, Painting and Color Coding

1.3 QUALITY ASSURANCE

- A. The intent of ductwork specifications is to obtain superior quality workmanship resulting in an installation that is absolutely satisfactory in both function and appearance. Provide ductwork in accordance with the specifications for each type of service.
- B. An approved contractor for this work under this division shall be:
 1. A specialist in this field and have the personnel, experience, training, skill, and the organization to provide a practical working system.
 2. Able to furnish evidence of having contracted for and installed not less than 5 systems of comparable size and type that have served their owners satisfactorily for not less than 5 years.
- C. Duct cleaning: Oil film on sheet metal should be removed before shipment to site. On-site, inspect ducts to confirm that no oil film is present. Remove any oil. If ducts contain dust and dirt, clean them immediately, prior to substantial completion and prior to using the ducts to circulate air. HVAC system components or duct work may only be cleaned, coated, or have applied to its surface disinfectants, pesticides or biocides that are registered and particularly labeled for use in HVAC systems by state and federal EPA.

1.4 GUARANTEE

- A. Guarantee ductwork for 1 year from the date of substantial completion. The guarantee covers workmanship, noise, chatter, whistling, or vibration. Ductwork shall be free from pulsation under conditions of operation.

1.5 CONTRACTOR COORDINATION

- A. Erect ducts in the general locations shown, but conform to structural and finish conditions of the building. Before fabricating any ductwork, check the physical conditions at the job site and make necessary changes in cross sections, offsets, and similar items, whether they are specifically indicated or not.

- B. Coordinate location of ductwork with structural members and Architectural drawings and requirements.

1.6 SHOP DRAWINGS AND SAMPLES

- A. Submit shop drawings of all ductwork layouts, including enlarged plans and elevations of all air handling equipment, and submit details of duct fittings, including particulars such as gauge sizes, welds, and configurations prior to starting work.
- B. Submit product data and sealing materials to be used.
- C. Submit sound attenuation data.
- D. Submit shop drawings in plan, elevation and sections, and three-dimensional view showing equipment in mechanical equipment areas.

PART 2 – PRODUCTS

2.1 STANDARDS AND CODES

- A. Except as otherwise indicated, sheet metal ductwork material and installation shall comply with the latest edition of SMACNA HVAC Duct Construction Standards. Air distribution devices (such as dampers) included in this specification shall comply with the latest applicable SMACNA Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems and NFPA 90A.

2.2 DUCT MATERIAL AND CONSTRUCTION

- A. Except for the special ducts specified below use lock forming quality prime galvanized steel sheets or coils up to 60" wide. Stencil each sheet with gauge and manufacturer's name. Stencil coils of sheet steel throughout on 10' centers with gauge and manufacturer's name. Provide certification of duct gauge and manufacturer for each size duct.
- B. Rectangular low and medium pressure duct constructed of sheet metal in accordance with the latest edition of SMACNA HVAC Duct Construction Standards.
- C. Medium pressure oval and round ductwork shall be spiral seam. Spiral lock-seam SMACNA Type RL-1. Fittings shall be welded construction.
 - 1. Galvanized
- D. Low pressure round ducts shall be shop fabricated with snap lock longitudinal seams. Ducts shall be constructed for a minimum of 2" w.g. static pressure.
- E. Dishwasher Hood Exhaust System: Welded 304 Stainless steel.
- F. Shower Area Exhaust Systems: Welded 304 Stainless steel.
- G. Kitchen exhaust duct: Welded Black steel, minimum 16 gauge

2.3 ACOUSTICAL DUCT

- A. Duct and fittings:
 - 1. Double wall acoustically treated.
 - 2. Annular space packed with fiberglass insulation.
 - 3. Perforated metal liner to provide specific acoustic impedance

4. Insulation 1.0 pcf. 1 inch thick
 5. United McGill Acousti-K27 spiral lockseam or approved equal
 6. Material as indicated below:
 - a. Paintable Galvanized Steel
- B. Pressure rating and tests as specified for single wall ductwork.

2.4 DUCT SEALING OF SEAMS AND JOINTS

- A. Follow seal classification as indicated in Table 1-2 of SMACNA "HVAC AIR DUCT LEAKAGE TEST MANUAL". Use seal class A for 4" w.g. static. All longitudinal and transverse joints and seams shall be sealed by use of a fireproof, non-hardening, and non-migrating elastomeric sealant. With the exception of continuously welded joints and machine made spiral lock seams, joints and seams made air tight with duct sealer.
1. Indoor applications – Foster 32-14
 2. Outdoor applications – Foster 32-17

2.5 FLEXIBLE DUCT LOW PRESSURE

- A. Construction:
1. Continuous galvanized spring steel wire helix, with reinforced metalized cover
 - a. The fabric shall be mechanically fastened to the steel helix without the use of adhesives.
 2. UL 181 Class I air duct label
 3. Reinforced vapor barrier jacket
 4. Rated for use at system pressure (6" wc minimum)
 5. Flexible duct connections from lateral taps to variable volume boxes or terminal boxes shall be rated at twice the maximum pressure rating of the medium pressure system.
- B. Fire hazard classification:
1. Flame spread rating 25 maximum.
 2. Smoke developed rating 50 maximum.
- C. Thermal characteristics:
1. R-6 BTU/hr/sq. ft./°F (when located in a conditioned plenum)
 2. R-8 BTU/HR/Sq.Ft./°F (when located in an unconditioned plenum)
 3. 2" minimum wall thickness insulation with 1" overlap
- D. Acceptable manufacturers:
1. Flexmaster
 2. Peppertree Air Solutions

2.6 FLEXIBLE DUCT MEDIUM/HIGH PRESSURE

- A. The duct shall be constructed of a heavy coated fiberglass cloth fabric supported by helical wound galvanized steel. The fabric shall be mechanically fastened to the steel helix without the use of adhesives.
- B. The internal working pressure rating shall be at least as follows with a bursting pressure of at least two times the working pressure:
Positive: 12" w.g.
Negative: 5" w.g.
- C. The duct shall be rated for a velocity of at least 5500 fpm.
- D. Suitable for operating temperature range of -20°F to +250°F.

- E. Factory insulate the flexible duct with fiberglass insulation.
 - 1. R-6 BTU/hr/sq. ft./°F (when located in a conditioned plenum)
 - 2. R-8 BTU/HR/Sq.Ft./°F (when located in an unconditioned plenum)
 - 3. 2" minimum wall thickness insulation with 1" overlap
- F. Cover the insulation with a fire retarding polyethylene vapor barrier jacket having a permeance of not greater than 0.10 perms when tested in accordance with ASTM E96, Procedure A.
- G. Acceptable manufacturers:
 - 1. Flexmaster
 - 2. Peppertree Air Solutions

2.7 FIRE DAMPERS

- A. Fire dampers for required wall ratings that are 95% minimum free area. Provide Type B or Type C UL dampers for low, medium and high-pressure rectangular, square or round ducts. Dampers shall be activated by a fusible link designed to react at 165°F. Install per manufactures recommendations to provide a UL assembly. Provide sealed sleeve to meet desired leakage performance.
- B. Acceptable Manufacturers:
 - 1. Ruskin
 - 2. Prefco Products
 - 3. Air Balance
 - 4. Greenheck, Inc.
 - 5. Nailor Industries
 - 6. Pottoroff
 - 7. Price

2.8 CEILING RADIATION DAMPERS

- A. Ceiling Radiation Dampers at location shown on plans constructed and tested in accordance with the current edition of UL555C of a minimum 22 gauge (0.8) blades, hinged in the center and held open with a 165° fusible link. Maximum blade height in the open position shall be 10" overall regardless of damper area. Maximum distance between blades held in the open position shall be 1-1/4" for units not requiring blade insulation and 1/4" for units with sheetrock blade insulation. Blades requiring radiation protection insulation shall utilize sheetrock. Refractory Ceramic or Mineral Wool Fiber is not allowed in the air stream. Radiation insulation outside of the air stream shall be Mineral Wool Fiber only. Ceramic Fiber Material is not approved for use. Units shall be constructed of a minimum 20-gauge (0.9) frame welded at all seams.
- B. Acceptable Manufactures
 - 1. Ruskin
 - 2. Prefco
 - 3. Air Balance
 - 4. Phillips
 - 5. Safe-Air
 - 6. Nailor Industries

2.9 WALL LOUVERS

- A. Coordinate with Architectural Drawings.

- B. All louver frames shall be a minimum of 0.08" extruded aluminum. All blades shall be a minimum of 0.081" extruded aluminum. Beginning point of water penetration at 0.01 oz/sq.ft. Shall be a minimum of 800 ft/min.
- C. Provide all louvers with removable aluminum bird screen with 1/4" mesh.
- D. All louvers shall be certified to meet the wind zone requirements of project location.
- E. Acceptable manufacturers:
 - 1. American Warming and Ventilation
 - 2. Arrow
 - 3. Greenheck
 - 4. NCA
 - 5. Pottorff
 - 6. Ruskin

2.10 FLUES FOR POWER EXHAUST AND HIGH EFFICIENCY BOILERS AND WATER HEATERS

- A. Double wall air insulated positive pressure chimney equal to Metalbestos, Van-Packer, Schebler or Metal-Fab. Chimney shall be rated for 550°F maximum flue gas temperature and with a UL tested pressure rating of 40 inches w.c. The interior pipe shall be constructed of AL 29-4C stainless steel and the exterior pipe shall be constructed of 304 stainless steel. Stack system shall be complete with a one inch air gap between inner liner and outer cover. Chimney shall be constructed and installed per UL-1738 and NFPA-211. All accessories shall be made by the same manufacturer and designed to be a part of a positive pressure chimney system.

2.11 DUCT LINING

- A. Duct lining shall be 1" thick, 1-1/2 lb. density, flexible lining coated on the air stream side to reduce attrition. Liner shall be Schuler Lina-Coustic, Certain-Teed Ultralite, or equal meeting requirements of NFPA 90-A. Provide I.A.Q. rated liner.

2.12 VOLUME DAMPERS

- A. Manual balancing dampers that meet or exceed the following minimum construction standards:
 - 1. Frame 16-gauge
 - 2. Blades 16-gauge
 - 3. Bearings corrosion resistant
 - 4. Concealed linkage
 - 5. Opposed blade dampers
- B. Acceptable manufacturer:
 - 1. Ruskin Model MD-35 or approved equal, by
 - 2. Arrow
 - 3. American Warming and Ventilating
 - 4. Nailor Industries
 - 5. Pottorff

2.13 ACCESS DOORS

- A. Round spin-in door of galvanized steel.
 - 1. Fire proof sealing gaskets and quick fastening locking devices
 - 2. Insulated door
 - 3. Conform to the requirements of the NFPA

4. Identification and use of each access door
5. UL label to match the construction in which it is installed
6. Cable attached to door and outer frame
7. Low leakage Access Door

- B. Acceptable Manufacturer
1. Flex master, Inspector Series
 2. Approved Equal

2.14 COMBINATION FIRE/SMOKE DAMPERS

- A. Combination fire/smoke dampers meeting the following requirements:
1. Each combination fire/smoke damper shall be 1-1/2 hour fire rated under UL Standard 555, 4th Edition, and shall be further classified by Underwriters Laboratories as a leakage Rated Damper for use in smoke control systems under the latest version of UL555S, and bear a UL label attesting to same. The damper manufacturer shall have tested, and qualified with UL, a complete range of damper sizes covering all dampers required by this specification. Testing and qualifying a single damper size is not acceptable. The leakage rating under UL555S shall be Leakage Class II.
 2. The damper frame shall be a minimum of 16 gauge, galvanized steel, formed into a structural hat channel shape with tabbed corners for reinforcement, as approved in testing by Underwriters Laboratories. Bearings shall be integral high surface area non-electrolytic materials construction to incorporate a friction free frame blade lap seal, or molybdenum disulfide impregnated stainless steel or bronze oilite sleeve type turning in the damper frame. The dampers shall be opposed blade type. The blades shall be constructed with a minimum of 16-gauge galvanized steel. The blade edge seal material shall be able to withstand 450°F. The jamb seals shall be flexible stainless steel compression type.
 3. As part of the UL qualification, dampers shall have demonstrated a capacity to operate (open and close) under HVAC system operation conditions, with pressures of at least 4" water gauge in the closed position, and 2,000 fpm air velocity in the open position.
 4. Each combination fire/smoke damper shall be equipped with a controlled 7 to 15 second heat-actuated release device. The electric EFL shall close and lock the fire/smoke damper during test, smoke detection, power failure or fire conditions through actuator closure springs. To prevent duct and HVAC component damage, the damper shall at all times be connected to the actuator for controlled closure in not less than 7 seconds and no more than 15 seconds. Instantaneous damper closure is unacceptable. After exposure to high temperature of fire, the damper must be inspected prior to reset to ensure proper operation. Release temperature is 165°F.
 5. Provide UL555S qualified electric actuator at 120 VAC.
 6. Provide air-foil type blades.
- B. Provide integral sleeves
- C. Acceptable Manufacturers:
1. Ruskin
 2. Air Balance, Inc.
 3. Greenheck, Inc.
 4. Nailor Industries
 5. Pottoroff
 6. Price

2.15 SMOKE DAMPERS

- A. Smoke dampers meeting the following requirements.
1. Each smoke damper shall be classified by Underwriters Laboratories as a leakage Rated Damper for use in smoke control systems under the latest version of UL555S, and bear a UL label attesting to same. The damper manufacturer shall have tested, and qualified with UL, a complete range of damper sizes covering all dampers required by this specification. Testing and qualifying a single damper size is not acceptable. The leakage rating under UL555S shall be Leakage Class II.
 2. The damper frame shall be a minimum of 16 gauge, galvanized steel, formed into a structural hat channel shape with tabbed corners for reinforcement, as approved in testing by Underwriters Laboratories. Bearings shall be integral high surface area non-electrolytic materials construction to incorporate a friction free frame blade lap seal, or molybdenum disulfide impregnated stainless steel or bronze oilite sleeve type turning in the damper frame. The dampers shall be opposed blade type. The blades shall be constructed with a minimum of 16 gauge, galvanized steel. The blade edge seal material shall be able to withstand 450°F. The jamb seals shall be flexible stainless steel compression type.
 3. As part of the UL qualification, dampers shall have demonstrated a capacity to operate (open and close) under HVAC system operation conditions, with pressures of at least 4" water gauge in the closed position, and 2,000 fpm air velocity in the open position.
 4. Provide UL555S qualified electric actuator at 120 VAC.
 5. Provide air-foil type blades.
- B. Provide integral sleeves.
- C. Acceptable Manufacturers:
1. Ruskin
 2. Air Balance, Inc.
 3. Greenheck, Inc.
 4. Nailor Industries
 5. Pottoroff
 6. Price

2.16 DIFFUSER FITTINGS LOW PRESSURE TAPS

- A. Fitting shall meet or exceed the following minimum construction standards:
1. Conical with a base diameter two inches larger than the tap diameter.
 2. Construct fitting and damper of galvanized steel in accordance with ASTM A 527, G90 finish.
 - a. Fitting with a 3/16-inch high stop bead approximately 2-1/2-inches from the discharge end of the fitting
 - b. Provide the fitting with a butterfly damper, damper rod, end bearings and heavy duty locking quadrant.
 - c. Size the length of the straight section of the fitting to match the damper blade diameter. Center the damper blade in the straight section.
 3. Match the fitting body gauge to the SMACNA duct gauge, but not less than:
 - a. Through 8 inches: 26 gauge; Damper blade 22 gauge
 - b. 10 inches and 12 inches: 24 gauge; Damper blade 22 gauge
 - c. 14 inches and 16 inches: 22 gauge; Damper blade 22 gauge
 - d. 18 inches and 20 inches: 20 gauge; Damper blade 20 gauge
 4. Fasten damper blade to a 3/8 X 3/8 continuous square rod with minimum (2) galvanized U-bolts.
 5. Support the damper rod to the fitting with airtight nylon end bushings / bearings.

6. Provide the damper with a self-locking regulator and handle.
7. Provide a 2" sheet metal stand-off to extend the regulator.
8. Flex duct grip area – 2 inches behind retaining bead
9. Flex duct retaining bead – 1 inch from end
10. Conical length of at least 3 inches
11. Barrel length of at least 9 inches

2.17 AUXILIARY DRAIN PANS

- A. Galvanized steel, same gauge and same bracing or cross breaks as a duct with same dimensions. Sides of pan turned up to 1-1/2", all joints soldered watertight. Pan is to be large enough to complete cover drip lines of unit.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Use construction methods and requirements as outlined in SMACNA HVAC Duct Construction Standards as well as SMACNA Balancing and Adjusting publications, unless indicated otherwise in the specifications. Refer to details on the drawings for additional information.
- B. Reinforce ducts in accordance with recommended construction practice of SMACNA. Provide additional reinforcement of large plenums as required to prevent excessive flexing and or vibration.
- C. Cross break or bead sheet metal for rigidity, except ducts that are 12" or less in the longest dimension.
- D. Where ducts pass through walls in exposed areas, install suitable escutcheons made of sheet metal angles as closers.
- E. At locations where ductwork passes through floors, provide watertight concrete curb around penetration.
- F. Support ducts where passing through floors with galvanized steel structural angles of adequate bearing surface.
- G. Metal or lined ductwork exposed to view through grilles, registers, and other openings shall be painted flat black. Do not install grilles, registers, or similar items until painting is complete.
- H. Fire Dampers shall be installed per manufacturer's recommendations to create a UL rated assembly.
- I. Install end bearing at all location where damper shaft penetrates duct wall.
- J. Clean duct to remove accumulated dust. Ducts shall be closed on ends between phases of fabrication to assure that no foreign material enters the ducts.

3.2 DUCTWORK

- A. Construct rectangular ducts and round ducts in accordance with the latest SMACNA HVAC Duct Construction Standards. Use the static pressure specified on the air handling unit schedule or fan schedules as a minimum for duct construction. All ductwork between the variable volume air handling units and the terminal units shall be constructed to the

medium pressure ductwork specification.

- B. Provide adjustable, galvanized splitter-dampers, pivoted at the downstream end with appropriate control device at each supply duct split.
- C. For branch ducts wider than 18", and when shown on drawings provide extractors with an appropriate control device at each rectangular zone or branch supply duct connection. Provide controllers for extractors. Branch ducts shall have a 45° angle in the direction of flow. Do not provide extractor at branch ducts to sidewall registers where the registers are within 10 feet of the main duct.
- D. Shop manufactured curved blade scoops may be used for branch duct takeoffs up to 18" wide. Taper scoop blade to the end, to prevent any sagging that may cut into, or damage duct liner if specified during operation.
 - 1. Construct shop manufactured scoops and splitter blades of galvanized sheet metal 2 full gauges heavier than equivalent sheet metal gauge of branch duct (up to 16 gauge).
 - 2. Check extractors, scoops and splitter blades thoroughly for freedom of operation. Oil bearing points before installing.
- E. Use pushrod operator with locking nut and butt hinges assembly.
- F. Provide opposed-blade volume dampers with an appropriate control device in each of the following locations:
 - 1. Return air ductwork
 - 2. Outside air branch duct
 - 3. Exhaust branch duct
 - 4. Exhaust connections to hoods except kitchen grease hoods or equipment
 - 5. In each zone at multi-zone unit discharge installed downstream of duct mounted re-heat coils
 - 6. At each outside air and return air duct connection to plenum of constant volume units
 - 7. At discharge side of constant volume boxes
 - 8. Where otherwise indicated or required for balancing coordinate location of additional dampers required by TAB Contractor.
 - 9. Provide multi-blade dampers when blade width exceeds 12". Provide end bearing where damper shaft penetrates duct wall.
- G. Elbows:
 - 1. Rectangular: Where square elbows are shown, or are required for good airflow, provide and install single-wall or airfoil turning vanes. Job-fabricated turning vanes, if used, shall be single-thickness vanes of galvanized steel sheets of the same gauge metal as the duct in which they are installed. Furnish vanes fabricated for the same angle as the duct offset. The use of radius elbows with a centerline radius of not less than 1-1/2 times the duct width may be provided in lieu of vaned elbows where space and air flow requirements permit.
 - 2. Round Oval Duct. Provide elbows with a centerline radius of 1-1/2 times the duct diameter or duct width. For round ducts, furnish smooth elbows or 5 piece, 90° elbows and 3 piece, 45° elbows.
- H. For control devices concealed by ceilings, furring, or in other inaccessible locations, furnish extension rods and appropriate recessed-type Young regulators, mounted on the surface of the ceiling or the furring, unless specified, or shown otherwise. Provide with chrome plated cover plates. Use only one mitered gear set for each control device.
- I. Install streamline deflectors at any point where dividing a sheet metal duct around piping

or where other such obstruction is permitted. Where such obstructions occur in insulated ducts, fill space inside streamliner and around obstructions with glass fiber insulation.

J. Insulated Flexible Duct:

1. Install in accordance with manufacturer's instructions, and the terms of its UL listing. Duct shall not exceed 6' in length. Make connections by use of sheet metal collars and stainless steel circular screw clamps. Clamps shall encircle the duct completely and be tightened with a worm gear operator to the point that will provide an airtight connection without unnecessary deformation of the duct. Provide one clamp on flexible duct and one clamp on external insulation. Vapor barrier jacket shall be tucked inside to conceal insulation material.
2. Construct bends over 45° with sheet metal elbows.

K. Duct Supports:

1. Horizontal ducts up to 40". Support horizontal ducts up to and including 40" in their greater dimension by means of #18 U.S. gauge galvanized iron strap hangers attached to the ducts by a minimum of two locations per side by means of screws, rivets or clamps, and fastened to inserts with toggle bolts, beam clamps or other approved means. Place supports on at least 8' centers. Use clamps to fasten hangers to reinforcing on sealed ducts.
2. Horizontal ducts larger than 40". Support horizontal ducts larger than 40" in their greatest dimension by means of hanger rods bolted to angle iron trapeze hangers. Place supports on at least 8' centers in accordance with SMACNA Standards.
3. Support vertical ducts where they pass through the floor lines with 1-1/2" x 1-1/2" x 1/4" angles for ducts up to 60". Above 60", the angles shall be increased in strength and sized on an individual basis considering space requirements.
4. Supports shall be suspended from structural or by independent support. Do not support from structural bridging. Upper attachments should be selected with a safety factor of 4 or 5 times actual load conditions and subject to Engineers approval. Double wrap straps over open web of joist.

- L. Branch connections for medium pressure ductwork shall be made with a conical lateral. Field installed conical branch ducts shall be minimum 20-gauge galvanized sheet metal, "Everdur" welded and coated with "Galvabar".

3.3 PLENUMS

- A. Return air plenums shall be rectangular galvanized sheet metal ductwork.
- B. Fabricate plenums upstream of fan of 16-gauge material.
- C. Fabricate plenums upstream of filters minimum 18-gauge material.

3.4 FLEXIBLE CONNECTIONS

- A. Where ducts connect to fans or air handling units that are not internally isolated, make flexible airtight connections using "Ventglas" fabric. The fabric shall be fire-resistant, waterproof and mildew resistant with a weight of approximately 30 ounces per square yard. Provide a minimum of 1/2" slack in the connections, and a minimum of 2-1/2" distance between the edges of the ducts. Also, provide a minimum of 1" slack for each inch of static pressure on the fan system. Fasten fabric to apparatus and to adjacent ductwork by means of galvanized flats or draw bands. Where connections are made in outdoor locations, seal fabric to metal with mastic.

3.5 ACCESS DOORS

- A. Install ductwork access doors as noted below, arranged for convenient access. Stencil each door for specific use. Install access doors in each of the following locations:
 - 1. Fire Dampers
 - 2. Smoke Dampers
 - 3. Smoke/fire Dampers
 - 4. Outside Air Dampers
 - 5. Duct Mounted Coils (up-stream and downstream)
 - 6. Control Dampers
- B. Size access door 1" smaller than ductwork.
 - 1. Available Sizes: 8", 10", 12", 18", 24"
- C. Construct access door air tight, and conform to recommendations of NFPA and SMACNA.
- D. Demonstrate suitability of access for the intended purpose. Install multiple access doors as required.

3.6 DUCT LINING

- A. Install glass fiber acoustical lining where shown on drawings. Secure to duct surfaces with Foster 85-62 / 85-60 or Childers CP-125-1 / CP-127 adhesive and sheet metal fasteners on 12" centers. Coat exposed edges and leading edges of cross-joints with adhesive.
- B. Provide metal nosing that is either channeled or "Z" profiled or are integrally-formed from the duct wall securely installed over transversely oriented liner edges facing the air stream at fan discharge and at any interval of lined duct preceded by unlined duct.
- C. Refer to Insulation & Liner Detail on drawings for locations requiring liner to be installed.
- D. Do not install liner in multi-zone unit ductwork.

3.7 SEALING OF SEAMS AND JOINTS

- A. Seal supply, return, exhaust and outside air duct systems.

3.8 FLUES

- A. Provide and install flues for all gas fired equipment.
- B. Refer to plans for all related locations.
- C. Contractor is responsible for coordinating stack sizing, stack drains, stack test ports, stack termination fittings and all other required fittings with the selected equipment manufacturers.
- D. All fittings and accessories shall be manufactured by the flue manufacturer. The flue shall be installed per manufacturer's instruction.
- E. Terminate flues at height above roof to prevent flue gas from entering the building.

3.9 DISHWASHER HOOD EXHAUST SYSTEM

- A. All material and fittings shall be 304 Stainless steel, welded joints, watertight

construction. Grade horizontal duct 1/4" per lineal foot to drain toward the washer.

3.10 SHOWER AREA EXHAUST SYSTEM

- A. All material and fittings shall be 304 Stainless steel, welded joints, watertight construction. Grade horizontal duct 1/4" per lineal foot slope down to grille connection. Install in accordance with Fig. 2-21 of SMACNA HVAC Duct Construction Standards.

3.11 KITCHEN EXHAUST DUCT

- A. All material and fittings shall be minimum 16 gauge, coated black steel to prevent rusting. All seams and joints in the kitchen exhaust duct, and penetrations of the hood enclosure to its lower outermost perimeter that directs and captures grease-laden vapors and exhaust gases shall have a liquid tight continuous external weld. All ducts shall be installed without forming dips or traps that might collect residues. Provide 18" x 18" or equal area at each elbow and as required for cleaning access, in direction of air flow. UL Listed access panel shall be located on the vertical wall of the duct 1-1/2" from the bottom of duct and shall be fitted with two handles, grease and air tight fitting access door and latch. All interior surfaces of ducts shall be accessible for cleaning and inspection purposes. Duct shall maintain minimum 1/4" per lineal foot slope to the exhaust hood. Provide duct over lay at the roof curb for a complete seal. Install kitchen exhaust system per local authority. In the absence of a local authority, the requirements of the Uniform Mechanical Code and NFPA 96 shall govern.

3.12 FUME HOOD EXHAUST SYSTEM

- A. All material and fittings shall be 304 stainless steel construction.

3.13 ACOUSTICAL DUCT

- A. Install in the following locations:
 - 1. Where indicated on the drawings

3.14 SCREENS

- A. Furnish and install screens on all duct, fan, etc., openings furnished by the Contractor that lead to, or are, outdoors; screens shall be No. 16 gauge, one-half inch (1/2") mesh in removable galvanized steel frame. Provide safety screens meeting OSHA requirements for protection of maintenance personnel on all fan inlets and fan outlets to which no ductwork is connected.

3.15 CONNECTIONS TO LOUVERS

- A. Make watertight connections to all louvers. Ductwork behind louver shall have watertight soldered joints for a minimum of three feet and be sloped to bottom of louver. Lap duct to be over bottom louver blade where possible.
- B. Where plenums are installed on inside of louver, construct such that bottom of plenum will lap over bottom blade of louver to drain any water that may enter.

3.16 PLENUMS

- A. Construct plenums with galvanized steel framing members and galvanized sheet steel, cross braced and rigidly braced with galvanized angles. Gauges and bracing shall conform to SMACNA recommendations for ductwork of like sizes. Openings for fans, access doors, etc., shall be framed with galvanized steel angles.

- B. Provide access doors.

3.17 AUXILIARY DRAIN PANS

- A. All condensate producing equipment installed above ceilings and in central plant area shall be provided with a welded stainless steel secondary drain pan installed below equipment entirely and extend a minimum of 4" beyond equipment footprint.
- B. With 3/4" welded nipple.
- C. Piped to local floor drains or floor sinks.

3.18 TESTING OF LOW PRESSURE DUCTWORK

- A. Test ductwork for leaks before concealing. Maximum allowable leakage is 5% of total airflow.
- B. Provide equipment necessary for performing tests, including rotary blower large enough to provide required static pressure at allowed CFM quantity, certified orifice section with proper papers, traceable serial numbers and pressure vs CFM leakage rate scale, U-tube gauge board complete with cocks, tubing, and inclined manometer for leakage rates.
- C. Mains: Test mains after risers and branches are tied in and all equipment set. Close runout connections and place fan in operation. Provide pressure in mains at 1-1/2 times design pressure. Visually inspect joints. Repair leaks detected by sound or touch. Release mains for completion after joints are tight.
- D. Ductwork down stream of terminal boxes, return, exhaust, and outside air ducts are to be visually inspected.

3.19 TESTING OF MEDIUM AND HIGH PRESSURE DUCT

- A. As the project progresses, test the ductwork in sections.
- B. Provide equipment necessary for performing tests, including rotary blower large enough to provide required static pressure at allowed CFM quantity, certified orifice section with proper papers, traceable serial numbers, and pressure vs. CFM leakage rate scale, U-tube gauge board complete with cocks, tubing, and inclined manometer for leakage rates.
- C. Finally as a complete system, test ductwork at a minimum of 2.5" with a maximum allowable leakage of 1% of the total design supply airflow.
- D. Test method as set forth in SMACNA "HVAC Duct Construction Standards".

END OF SECTION

SECTION 23 33 19 - DUCT SILENCERS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish and install duct silencers.

1.2 RELATED WORK

- A. Division 23 Mechanical.
 - 1. Ductwork.
 - 2. Air Balance.

1.4 SUBMITTALS

- A. Submittal to submittal drawings detailing all duct silencer data specified in the mechanical drawing schedule.
- B. Submittal shall include performance sheet for each air device type. Performance sheet shall include NC levels, throw, and total pressure loss at various air flows.
- C. Silencer manufacturer shall submit certified laboratory performance obtained using ASTM E477-13. The laboratory must be NVLAP accredited for the ASTM E477-13 test standard and a copy of the accreditation certificate must be included with submittals. Data from non-NVLAP accredited test facilities is not acceptable.
- D. Submitted silencer pressure drops should not exceed those listed in the silencer schedule unless approved by project engineer. Silencer pressure drop measurements shall be made in accordance with ASTM E477-13. 4. Submitted silencer dynamic insertion loss and self-noise data should satisfy values listed in the silencer schedule at the project's air distribution system airflow requirements. ASTM E-477-13 tests to obtain this data shall be conducted in the same facility and utilize the same silencer.
- E. Silencer dynamic insertion loss shall not be less than that listed in the silencer schedule unless approved by the project engineer.
- F. Silencer generated noise shall not be greater than that listed in the silencer schedule unless approved by the project engineer.
- G. The silencer manufacturer shall provide, for approval, acoustic calculations for relevant duct systems with silencers to validate that the submitted silencers will satisfy occupied space design guidelines. Use sound power levels of actual equipment scheduled for installation on project. Acoustic Analysis shall include breakout noise calculations as required. In the absence of specified background noise level criteria, the guidelines outlined in the 2015 ASHRAE Applications Handbook Chapter 48, Table 1 shall apply.

1.4 SHIPPING PROTECTION

- A. Silencers shall be shipped with factory-installed end caps

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Price

- B. Vibro-Acoustics
- C. Kinetic Noise Control
- D. IAC Acoustics
- E. Ruskin

2.2 GENERAL REQUIREMENTS

- A. Silencers shall be of the size, configuration, capacity and acoustic performance as scheduled on the drawings. Silencers shall be fabricated by the same manufacturer.
- B. Silencer inlet and outlet connection dimensions must be equal to the duct sizes shown on the drawings. Duct transitions at silencers are not permitted unless shown on the contract drawings or approved by the project engineer.

2.3 CONSTRUCTION

- A. Silencers shall be constructed in accordance with ASHRAE and SMACNA Standards for the pressure and velocity classification specified for the air distribution system in which it is installed.
- B. Casing seams and joints shall be lock-formed and sealed or stitch welded and sealed except as noted, to provide leakage-resistant construction.
- C. Airtight construction shall be achieved by use of a duct-sealing compound supplied and installed by the contractor at the jobsite.
- D. Perforated steel shall be adequately stiffened to insure flatness and form. Spot welds shall be painted as required.
- E. Fire-Performance Characteristics: Silencer assemblies, including acoustic media fill, natural cotton fiber, sealants and acoustical spacers shall have Class 1 flame spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested according to ASTM E84, NFPA 255 or UL 723.
- F. Material gauge thickness:
 - 1. Material gauges noted in other sections are minimums and shall increase as required for the system pressure and velocity classification.
 - 2. The silencers shall not fail structurally when subjected to a differential air pressure of 8 inches water gauge.
- G. Outer casing shall be ASTM A 653/A 653M, G90 galvanized sheet steel, gauge as listed below:
 - 1. Rectangular Silencers, including STC-rated models: 22 gauge
 - 2. Rectangular Elbow Silencers: 22 gauge
 - 3. Circular Silencers:
 - a. For units up to 20 inches in diameter: 22 gauge
 - b. For units 21 through 44 inches in diameter: 18 gauge
 - c. For units over 44 inches in Diameter: 16 gauge
 - d. Transitional Silencers: 22 gauge
- H. Rectangular Elbow Silencers: 1. Acoustical splitter/baffles shall be internally radiused and aerodynamically designed for efficient turning of the air.

- I. Transitional Silencers shall occur internal to the silencer such that the height of the gap or air passage is changing with the length of the splitters/baffles.
- J. Inner perforated metal liner shall be supplied in accordance with ASTM A 653/A 653M, G90 galvanized sheet steel in the following gauge thicknesses according to silencer type or connection size:
 1. Rectangular Silencers: 22 gauge
 2. Rectangular Elbow Silencers: 22 gauge
 3. Circular Silencers: 22 gauge
 4. Transitional Silencers: 22 gauge
- K. Principal Sound-Absorbing Mechanism:
 1. Packless (No-Media) Silencers:
 - a. Models shall not contain absorptive media. Attenuation shall be achieved with controlled impedance membranes and broadly tuned resonators.
 2. Absorptive (Dissipative) and Film Lined Silencers:
 - a. Standard Acoustic media:
 - 1) Media shall be of acoustic quality, shot-free glass fiber insulation with long, resilient fibers bonded with a thermosetting resin. Glass fiber density and compression shall be as required to insure conformance with laboratory test data.
 - 2) Media shall be packed with a minimum of 15% compression during silencer assembly.
 - 3) Media shall be resilient such that it will not pull apart during normal applications, and shall resist settling, breakdown, and sagging from vibration. Media shall not rot, mildew, or otherwise deteriorate, and shall have sufficient flexibility to readily form around corners and curved surfaces.
 - 4) Media shall not cause or accelerate corrosion of aluminum or steel.
 - b. Natural cotton and film lined natural cotton:
 - 1) Media shall be natural cotton fibers treated with an EPA registered, non-toxic borate solution, and "flash dried" to actively inhibit the growth of mold, mildew, bacteria, and fungi.
 - 2) Media shall not contain formaldehydes, phenolic resins or Volatile Organic Compounds (VOC's) that can off-gas and/or cause health concerns.
 - 3) Media shall be 100% recyclable and comply with UL181 and NFPA 90A. Insulation shall be packed with a minimum of 15% compression during silencer assembly.
 - 4) Media shall not cause or accelerate corrosion of aluminum or steel. Glass fiber, fiberglass and mineral wool are not permitted as a substitute for natural cotton.
- L. Media Protection:
 1. Dissipative silencers:
 - a. Where indicated on the silencer schedule, media shall be encapsulated in glass fiber cloth to help prevent shedding, erosion and impregnation of the glass fiber.
 - b. Axial Fan silencers shall have a glass fiber cloth liner.
 2. Film Lined silencers:
 - a. The acoustic media shall be completely wrapped with polymer film to help prevent shedding, erosion and impregnation.
 - b. The wrapped acoustic media shall be separated from the perforated metal by a factory-installed acoustically transparent spacer.

- c. The spacer shall be flame retardant and erosion resistant.
 - d. Mesh, screen or corrugated perforated liner will not be acceptable as a substitute for the specified spacer.
 - e. Silencer manufacturer shall provide a written test report showing silencer assemblies have Class 1 flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested according to ASTM E 84, NFPA 255 or UL 723.
3. HTL Casings:
- a. Where indicated on the silencer schedule, silencers shall have high transmission loss (HTL) walls externally applied and completely sealed to the silencer casing by the silencer manufacturer.
 - b. If requested by the project engineer, relevant breakout noise calculations shall be provided to ensure compliance with the relevant room noise criteria that are based on the sound power levels of the specified equipment.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install silencer according to manufacturer's written installation instructions.

3.2 FIELD QUALITY CONTROL

- A. Ensure duct silencers are installed with airflow arrows in direction of airflow.

END OF SECTION

SECTION 23 34 16 - FANS

PART 1 – GENERAL

1.1 WORK INCLUDED

- A. Furnish and install fans, including centrifugal, axial and propeller types, with supplemental equipment.

1.2 RELATED WORK

- A. Division 23 Mechanical:
 - 1. Ductwork
 - 2. Vibration Isolation
 - 3. Air Balance
 - 4. Electrical Provisions of Mechanical Work

1.3 PERFORMANCE

- A. Provide fan type, arrangement, rotation, capacity, size, motor horsepower, and motor voltage as shown. Fan capacities and characteristics are scheduled on the drawings. Provide fans capable of accommodating static pressure variations of +10% of scheduled design at the design air flow.
- B. Rate fans according to appropriate Air Moving and Conditioning Association, Inc. (AMCA), approved test codes and procedures. Supply fans with sound ratings below the maximums permitted by AMCA Standards. All fans provided must be licensed to bear the Certified Ratings Seal.
- C. Statically and dynamically balance all fans.
- D. Motors shall be sized so that they do not operate within the motor service factor.

1.4 SUBMITTALS

- A. Submit fan performance curves with system operating point plotted on curves.
- B. Submit manufacturer's printed installation instructions.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Cook
- B. Greenheck
- C. Penn Barry Ventilator
- D. Twin City Fans

2.2 PROTECTIVE COATINGS

- A. Manufacturer's Standard. Apply to fans, motors and accessories, the manufacturer's standard prime coat and finish, except on aluminum surfaces or where special coatings are required.

- B. Galvanizing. After fabrication of the parts, hot-dip coat surfaces that require galvanizing. Where galvanizing is specified, a zinc coating may be used. After fabrication, apply the zinc coating and air-dry the coating to 95% pure zinc. Acceptable zinc coatings include Zincilate, Sealube, Amercoat, Diametcoat, or an approved equal.

2.3 SUPPLEMENTAL EQUIPMENT

- A. Motor Covers. Provide weatherproof motor covers for installations out of doors. Apply the same finish as used on the fan.
- B. Belt Drives:
 - 1. Unless otherwise specified for belt-driven fans, equip the fan motors with variable pitch sheaves. Select the sheave size for the approximate midpoint of adjustment and to provide not less than 20% speed variation from full open to full closed. Size drives for 150% of rated horsepower. Key the fan sheave to the fan shaft.
 - 2. Nonadjustable motor sheaves may be used for motor sizes over 15 horsepower, at the Contractor's option. However, if changing a nonadjustable sheave becomes necessary to produce the specified capacity, the change must be made at no additional cost.
 - 3. Provide belt guards and apply the same finish as used on the fan.
 - 4. Oil and heat resistant, nonstatic type belts.
 - 5. Bearings shall be designed and individually tested specifically for use in air handling applications. Construction shall be heavy duty, regreasable, ball type, in a pillow block, cast iron housing, selected for a minimum L50 life in excess of 200,000 hours at maximum catalog operating speed.
- C. Safety Disconnect Switch: Provide a factory-wired to motor, safety disconnect switch on each unit.
- D. Relief Vents and Air Inlets: Provide vents and inlets with aluminum frames and 1/2" mesh, galvanized bird screens. Include dampers where shown.
- E. Prefabricated Roof Curbs: Furnish prefabricated roof curbs as detailed. The minimum height is 14". Include a resilient pad on each roof curb so the equipment can be mounted on the top flange for proper seal. Coordinate roof slope and curb to ensure equipment is installed in level position. Provide double shell to protect insulation from damage.
- F. Where motorized damper is scheduled:
 - 1. The motor and damper are specified in the Building Management and Control System Specification.
- G. All fans are to be provided with a durable, deep etched, .025" thick, factory installed aluminum identification plate with the following information. Plates are to be furnished with four mounting holes.
 - 1. Fan mark as indicated on the Contract Drawings.
 - 2. Serial number
 - 3. Model number
 - 4. Capacity (CFM) and static pressure.
 - 5. Motor HP
 - 6. Motor Amps
 - 7. Manufacturer
 - 8. Motor phase
 - 9. Number of Belts/Make/Size
 - 10. Motor volts

2.4 VENTILATION AND EXHAUST FANS

- A. Provide the ventilation and exhaust fans shown on the drawings.
- B. Provide each motor with internal overload protection.
- C. Provide approved safety screen where inlet or outlet is exposed.
- D. Provide duct flanges where required for connections.
- E. Furnish kitchen hood exhaust fans with vented curb extension that meets NFPA 96, cleanout port, grease tap, curb seal, drain connection and hinge kit.
- F. Furnish supply fans with 1" aluminum, washable filter section.

2.5 ROOFTOP VENTILATION AND EXHAUST SYSTEMS

- A. Provide the rooftop ventilation and exhaust systems shown on the drawings.
- B. Provide each motor with internal overload protection.
- C. Components:
 - 1. Aluminum, stainless steel or plastic coated bird guard.
 - 2. Screws and fasteners of stainless steel or nonferrous material.
 - 3. All aluminum construction unless indicated otherwise on fan schedule.
- D. Welded construction, corrosion resistant fasteners, minimum 16 gauge marine alloy aluminum.
- E. Aluminum base shall be continuously welded curb cap corners.

2.6 GRAVITY ROOF-TOP INTAKE AND RELIEF VENTS

- A. Provide the rooftop intake and relief vent systems shown on the drawings.
- B. Provide with aluminum, stainless steel or plastic coated bird guard.
 - 1. Screws and fasteners of stainless steel or nonferrous material
 - 2. All aluminum construction
- C. Welded construction, corrosion resistant fasteners, minimum 16-gauge marine alloy aluminum.
- D. Aluminum base shall be continuously welded curb cap corners.

2.7 OSCILLATING AIR CIRCULATOR FAN

- A. three speed CFM Low 1657 – CFM Medium 2060 – CFM High 3100
- B. Totally enclosed motor voltage – 120 Voltage – 60 Hz
- C. Cast Aluminum 20-inch diameter, three blade fan with OSHA Guard
- D. Wall Mounted
- E. Factory wired 10', 3 conductor with ground molded plug

- F. Acceptable Manufacturer: Dayton 4PRV7 or approved equal

2.8 AUXILIARY ANGLE FILTER

- A. Provide a duct mounted inline low velocity angled filter box for the outside air supply systems.
- B. Filter box shall be upstream of any ductwork taps to VAV boxes.
- C. Maximum pressure drop shall be 0.5 inches static pressure.
- D. Provide continuous filter rails and a double wall hinged access door to allow easy filter replacement.
- E. Filter box shall be installed with a maximum height of 6'-0".
- F. Standard sizes 16x20x2, 16x25x2, 20x20x2, 20x25x2 only.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install fans according to the manufacturer's instructions and in the locations shown on the drawings.
- B. Do not operate fans or fan powered devices for any purpose until ductwork is clean, filters in place, bearings lubricated and the fan has been run under observation.
- C. Roof mounted fans and gravity roof-top intake and relief vents shall be secured to the curb with stainless steel lag screws at a minimum of 6-inches on center. Follow manufacturer's installation instructions if they are more stringent. Install roof mounted equipment in a level position. Units shall be seated on properly sized curb. Gap between base of the fan and top of the curb shall be sealed with neoprene 1" x ¼" gasket. Gasket shall be glued or attached with pressure sensitive adhesive.
- D. Install curbs and equipment in level position.
- E. Ceiling mounted in-line centrifugal blowers
 1. Shall be suspended from structure with 1/2-inch zinc plated all-thread rods secured to structure.
 2. Provide sub-structure where required.
 3. Mount bottom of fan no more than 18-inches above the finished ceiling height.

3.2 EXTRA MATERIALS

- A. Provide two sets of belts for each fan, not including the set installed on the fans. Tag set to identify fan.

END OF SECTION

SECTION 23 36 17 - DUAL DUCT VARIABLE VOLUME TERMINAL UNITS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish and install dual duct variable volume terminal units with mixing attenuator, including hangers, controls and other required elements.

1.2 RELATED WORK

- A. Division 23 - Mechanical.
 - 1. Ductwork
 - 2. Air Balance
 - 3. Electrical Requirements for Mechanical Work
 - 4. Building Management and Control System

1.3 COOPERATION WITH OTHER TRADES

- A. Coordinate this work with work under Division 26 Electrical, to ensure that intended functions of lighting and air systems are achieved.
- B. Coordinate the primary (input) voltage with the electrical power source. Refer to the Electrical Drawings for specific requirements.
- C. Coordinate multi-point sensor locations with Building Management Control System contractor.

1.4 SUBMITTALS

- A. Submit product data for control devices, terminal boxes, and similar equipment for review prior to placement of purchase order.
- B. Submit for each box the following information:
 - 1. Box size
 - 2. Inlet size
 - 3. Box number
 - 4. Box designation
 - 5. Minimum / Maximum CFM

1.5 QUALITY ASSURANCE

- A. Make air flow tests and sound level measurements in accordance with applicable ASHRAE Standards 130-96 and ARI 880-98.
- B. Manufacturer shall certify cataloged performance and ensure correct application of terminal units.
- C. Sound power levels to occupied space shall not exceed the NC levels specified in 23 05 47 as calculated using ARI 885-98 Appendix E attenuation factors for mineral tile ceiling.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Titus.
- B. Krueger
- C. Price
- D. Nailor
- E. Metalaire

2.2 BOX CONSTRUCTION

- A. Galvanized 20-gauge steel casing with suspension lugs.
- B. Lined with minimum 1.5 PCF / 1.5" thick fiber free thermal and acoustical insulation.
 - 1. Flame spread not higher than 25.
 - 2. Smoke developed rating not higher than 50.
 - 3. Condensation on the exterior of the box is not approved.
 - 4. Coat all cut edges of liner with NFPA approved sealant.
 - 5. Lining shall pass UL 181, NFPA 90A and ASTM C 665.
- C. Provide access to controls without disturbing duct connections. Limit the size of access doors to 24 inches. Where required, provide multiple access doors. Gasket each door in the unit casing.
- D. Components shall be constructed of corrosion resistant materials.
- E. Casing leakage shall not exceed 2.0% of scheduled design airflow at 3.0" WG interior casing pressure.
- F. Seal casing joints with approved adhesive if required to meet the maximum casing leakage rate.
- G. The maximum overall height of the dual duct variable air volume unit shall not exceed available ceiling space.
- H. Maximum static pressure through box shall not exceed 0.2" w.g.
- I. Maximum velocity through inlets should not exceed 2,000 fpm.

2.3 COMPONENTS

- A. Primary variable air volume damper that controls the air quantity in response to a space sensor.
- B. Multi-point airflow sensors at locations as required by Building Management Control System.
- C. Controller enclosure
- D. Mixing attenuator.

2.4 PRIMARY AIR DAMPER AND ACTUATOR

- A. The control actuator shall vary the primary air damper in response to the control signal.
 - 1. Damper leakage at shutoff shall not exceed 2.0% of the maximum scheduled schedule design airflow at 3" WG inlet static pressure and be tested in accordance with ASHRAE 130.
 - 2. Locate the damper inside the unit.
 - 3. Damper connection to the operating shaft shall be a positive mechanical connection.
 - 4. Damper shall have bearings at all penetrations of inlet tube and terminal housing. Penetration of damper shaft in terminal lining shall have seal at surface of lining to prevent fiber entrainment through rotation of damper shaft.
 - 5. Two damper stop pins shall be provided. One pin shall ensure damper cannot rotate beyond full closed position. One pin shall ensure damper cannot rotate beyond full open position.
 - 6. Inlet tube shall have rolled bead (outward position) prior to penetration point of flow sensor tubing to provide stop point for hard duct and anchor point for flex duct.

2.5 AIR FLOW CONTROL

- A. Provide a flow control device that will limit the maximum CFM of the unit to that scheduled on the drawings.
 - 1. Air quantity shall be factory set.
 - 2. Thermostat signal shall reset the flow control device to reduce primary air quantity to match load requirements.
 - 3. Control shall be pressure independent.
 - 4. Each terminal shall incorporate a flow cross sensor with pick-up points connected to a center averaging chamber to ensure the following performance:
 - a. Controller fidelity shall be +/-5% of set volume with a flex inlet configuration and inlet static variation of 0.5" WG to 6.0" WG.
 - 5. Coordinate flow sensor locations with Building Management and Controls Contractor.
 - 6. Flow sensor tubing shall have gaskets at penetration point of inlet tube.
 - 7. Flow sensor shall be center averaging type. Non-center averaging flow sensors are not acceptable.
 - 8. Flow sensor tubing to be connected with brass barb fittings.
 - 9. Tubing from air flow sensor to DDC controller shall be Tygon tubing (no exceptions)

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Deliver and store products in a clean and dry place. Protect products from the weather, dirt, dust, construction debris and physical damage.
- B. Install each unit in accordance with the manufacturer's printed installation instructions.
- C. Suspend each unit from 1/4" electroplated zinc thread rods secured from structure.
 - 1. Provide sub-structure where required.
 - 2. Mount bottom of terminal unit no more than 18" above the finish ceiling height.
 - 3. Install units so that they are level and plumb.
- D. Install a straight length of rigid ductwork upstream of all boxes. Provide at least 3 primary air inlet diameters of straight ductwork upstream of the primary air inlet connections.

Flexible duct connections at boxes are allowed but are not a substitute for the straight run of rigid duct. A maximum of 4' of flexible duct is allowed at each box. All changes in direction shall be made with rigid duct. Seal connection at box, as required to comply with system maximum allowable leakage.

- E. Coordinate the location of each variable air volume unit to ensure proper clearance so that all components are accessible and not blocked by other trades. Provide no less than the code required clearances to electrical components.
- F. Cover and seal the openings of the VAV inlets during construction to prevent the inside from getting dirty. Where VAV units are considered dirty, as determined by the Architect / Engineer / Owner, clean the VAV units with a vacuum machine, and then wipe all surfaces with a cleaning agent, using clean rags.

3.2 MISCELLANEOUS CONTROLS

- A. The following equipment items are to be furnished by Building Management and Control System and installed by Fan Powered Terminal Unit manufacturer:
 - 1. Automatic temperature control card (DDC).
 - 2. Damper actuator.
 - 3. Discharge air temperature sensor
- B. The following equipment items are to be furnished and installed by the Dual Duct Unit manufacturer:
 - 1. Damper.
 - 2. Multi-point flow sensors.
 - 3. Controller enclosure.
 - 4. Tubing from air flow cross to DDC controller.
 - 5. Factory provided external taps for air flow readings with corresponding chart/label on box near dampers.
 - 6. Mixing attenuator.
- C. Coordinate location of controller enclosure, inlet sensors, wiring of terminal equipment controller and transformer required by the Building Management and Control System contractor.

END OF SECTION

SECTION 23 37 13 - AIR DEVICES

PART 1 – GENERAL

1.1 WORK INCLUDED

- A. Furnish and install air distribution devices, including grilles, diffusers, registers, dampers, and extractors.

1.2 RELATED WORK

- A. Division 23 Mechanical.
 - 1. Ductwork.
 - 2. Air Balance.
 - 3. Electrical Requirements for Mechanical Work.

1.3 COOPERATION WITH OTHER TRADES

- A. Coordinate this work with work under Division 26 Electrical, to ensure that intended functions of lighting and air systems are achieved.

1.4 SUBMITTALS

- A. Submit product data for outlets, grilles, registers, control devices, and similar equipment for review prior to placement of purchase order.
- B. Submittal shall include performance sheet for each air device type. Performance sheet shall include NC levels, throw, and total pressure loss at various air flows.

1.5 FINISHES

- A. Paint exposed devices with factory standard prime coat, or factory finish coat, as specified.

PART 2 – PRODUCTS

2.1 DIFFUSERS, GRILLES AND REGISTERS - Refer to Drawing Schedule.

- A. Perforated grilles shall not be used for supply air, return air or exhaust air.
- B. Stamped face, Egg Crate (of any material) or door grilles shall not be used.
- C. Acceptable Grilles and Diffusers:
 - 1. Supply Air Diffusers/Grilles
 - a. Lay-in Square Cone, Steel or Aluminum, 360° pattern
 - b. Lay-in Square Plaque, Steel or Aluminum, 360° pattern
 - c. Surface Mount Square Louver Face, Steel or Aluminum, 360° pattern
 - d. Round Cone, Steel or Aluminum, Steel or Aluminum, 360° pattern
 - e. T-Bar Slot, Steel or Aluminum
 - f. Double Deflection (Sidewall), Steel or Aluminum
 - 2. Return Air Grilles
 - a. Louvered face, Steel or Aluminum, 45° deflection, 3/4" blade spacing
Surface or lay-in type

2.2 ACCEPTABLE MANUFACTURERS

- A. Titus.
- B. Krueger.
- C. Nailor Industries.
- D. Metalaire
- E. Price

2.3 ACCESSORIES

- A. Supply Grille Extractors. Provide supply grilles with an air control device capable of positively regulating the volume of air extracted from the supply duct. Select extractors similar to Titus Model AG25, tight-closing in the minimum position. Include a key-operated or worm-gear adjusting mechanism to facilitate positioning from the grille opening. Where adjustment is not accessible at the grille opening, provide a square control rod equipped with a locking quadrant.
- B. Mounting Frames. Provide each grille or register not equipped with a removable core with a companion, all-purpose mounting frame constructed like grille frame to facilitate installation and removal of the grille or register without marring adjacent mounting surfaces.
 - 1. Furnish frames with 1/2" thick sponge rubber gasket to prevent air leakage.
 - 2. Provide a frame that neatly fits the grille. Mounting frames will not be required for grilles or registers mounted directly on exposed ductwork.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Do not install ceilings adjacent to fixtures until installation of fixtures, air supply assemblies, return-air blank-off strips and flexible duct have been approved. Remove and reinstall any part of the installation found incorrect.

3.2 INSTALLATION

- A. Louvered diffuser outlets mount tight against the ceiling. Fasten outlets to ductwork with sheet metal screws.

END OF SECTION

SECTION 23 41 00 - AIR FILTRATION

PART 1 – GENERAL

1.1 WORK INCLUDED

- A. Furnish and install air filters.

1.2 RELATED WORK

- A. Division 23 Mechanical.

1.3 SUBMITTALS

- A. Submit manufacturer's product data sheets and capacity information as specified.
- B. Submit recommended Dirty Filter pressure drop.

PART 2 – PRODUCTS

2.1 MEDIUM EFFICIENCY AIR FILTERS

- A. The filter cells:
 - 1. Pleated media.
 - 2. Disposable type.
 - 3. Contain not less than 4.6 sq. ft. of filtering media per square foot of face area.
 - 4. 18 pleats per linear foot of filter.
 - 5. 2" thick.
- B. Media of reinforced nonwoven cotton fabric treated with adhesive and continuously laminated to a supporting steel wire grid conforming to the configuration of the pleats.
 - 1. Seal the media pack in a water resistant cardboard frame.
- C. Rated average dust spot efficiency of not less than 80%.
 - 1. Average synthetic arrestance in excess of 98% when tested in accordance with the ASHRAE 52-68 test standard.
- D. Filter capable of operating with variable face velocities up to 500 fpm without impairing efficiency.
- E. Initial resistance to air flow:
 - 1. 500 fpm - 0.41" WG.
- F. UL listed with Class II rating.
- G. Air Filter Inc. Astro-Pleat MERV 13 minimum
- H. Provide one spare set for a complete change, in original cartons, for Owner's use during the warranty period.
- I. Standard sizes 16x20x2, 16x25x2, 20x20x2, 20x25x2 only. If 1" filters are only option for equipment, sizes must be standard sizes as listed.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install the filters in accordance with the manufacturer's instructions.

END OF SECTION

**SECTION 23 52 35 - GAS-FIRED MODULATING HOT
WATER BOILER (Condensing)**

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. This section specifies a packaged, gas-fired, power type condensing stainless steel or cast iron boiler complete with all controls and trim for indoor installation.
- B. 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.
- C. 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.

1.2 RELATED WORK

- A. Division 23 - Mechanical
 - 1. Hot Water Piping
 - 2. Gas Piping
 - 3. Ductwork
- B. Section 23 05 48 HVAC Vibration Isolation
- C. Section 23 05 50 Noise Control for Mechanical Systems

1.3 PERFORMANCE

- A. Provide performance as scheduled on drawings. Boiler shall be certified for up to 99% efficiency.

1.4 WARRANTIES

- A. The boiler manufacturer shall warrant each boiler, including boiler, trim, boiler control system, and all related components, accessories, and appurtenances against defects in workmanship and material for a period of five (5) years from date of substantial completion. Heat exchanger and fuel burner shall be warranted for a period of ten (10) years from date of substantial completion. Warranty shall cover both parts and labor.

1.5 SUBMITTALS

- A. Submitted boiler must fit within the space allocated as illustrated on drawings and shall include a minimum of 24" unobstructed clearance on all sides.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Hydrotherm KN Lochinvar Crest with Hellcat
- B. Lochinvar Crest with Hellcat
- C. P-K Sonic
- D. Raypak XVers
- E. RBI Flexcore
- F. Viessmann VitroCrossal 300

2.2 PERFORMANCE CRITERIA

- A. Each boiler shall be capable of operating continuously at rated capacity while maintaining a CSA certified efficiency of not less than 92 % on 500 MBH input boilers and less and not less than 95% on larger than 500 MBH input boilers. Each boiler shall be capable of operating with a minimum outlet water temperature of 68° F.
- B. Boiler shall comply with ASME Section IV for 80 psig, max 200° F (100 psig on 1500 MBH and larger units).
- C. 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 inch wc to the inlet gas valve. Maximum inlet gas pressure shall not exceed 14 in. WC.
- D. Boilers shall be certified for low NOx by the TCEQ. NOx emissions shall not exceed 30 PPM when referenced at 3% O2 at all firing rates.
- E. The burner, gas train and controls shall conform to the requirements of I.R.I./G.E. Gap.

2.3 BOILER DESIGN

- A. Each hot water boiler shall consist of a horizontal, stainless steel or cast iron 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.
- 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.
- F. 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

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between the sections are not permitted.

- G. 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.
- H. An observation port shall be located on the boiler to allow for observation of the burner flame.

2.4 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.
 - 6. Separate inlet and outlet water temperature sensors capable of monitoring flow
 - 7. Exhaust temperature sensor
 - 8. Provide condensate neutralization kit (shipped loose).

2.5 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 operate at 6000 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 be 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 Micro Processor 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

2.6 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 inch 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

2.7 IGNITION SYSTEM

- A. Each boiler shall be equipped for direct spark ignition

2.8 COMBUSTION AIR CONTROL SYSTEM

- 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 insure that combustion air is supplied.
 3. High exhaust back pressure switch

2.9 BURNER CONTROL SYSTEM

- A. The control system shall be supplied with a 24 VAC transformer (120 VAC, single phase,

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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.

2.10 BOILER 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, sensor values such as inlet, outlet, flue gas and outdoor air.

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.

2.13 HYBRID SEQUENCE CONTROLLER

- A. Provide a stand alone boiler sequence controller that is capable of controlling a combination of condensing and non-condensing boilers. Sequence controller shall sequence the lead boiler based on its condensing capabilities to provide the most efficient operation. Controller shall operate based on outdoor reset, see specification Section 23 09 33 for reset schedule. Controller shall visually display relay status, firing rate of each boiler, header temperature, outdoor air temperature. Coordinate wiring of this controller with mechanical and controls contractor.

2.14 CARBON MONOXIDE MONITORING SYSTEM

- A. Provide and install a manual reset Carbon Monoxide Detector located within the boiler room. The Carbon Monoxide Detector and the boilers shall be interlocked so that the burners will

not operate when the level of CO in the room rises above 100ppm. The Carbon Monoxide detector shall disable the boiler's burner upon loss of power to the detector.

- B. Carbon Monoxide Sensor with two year warranty by U.S. Draft Co. Model CGM-505 with model XB expansion module.
 - 1. Provided with pre-programmed dry contacts to shut down equipment during unsafe operation.
 - 2. NEMA 1 Enclosure
 - 3. Complies with Texas State Boiler Code 65.603-2015
 - 4. Additional features shall include 0-10 VDC control signal out, visual alarm and audible alarm.
 - 5. Provide expansion board for additional equipment interlocks.
- C. Carbon Monoxide Detector shall prevent boiler from operating when high levels of CO are detected and not be capable of being bypassed when boiler is operating in the hand mode.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install isolation valves and unions on supply and return water lines to boiler.
- B. Install strainer, drain with valve, pressure and temperature gauge on return water line to boiler.
- C. Install main gas cock, drip leg and union close to boiler.
- D. Install on 4" concrete pad and place into operation in accordance with manufacturer's instructions. Pipe as detailed on drawings.
- E. Provide Category IV vent stack material. Mechanical contractor shall coordinate draft requirements and other venting requirements between stack supplier and boiler supplier.
- F. Install boilers, piping and accessories in accordance with the manufacturer's installation instructions and state boiler code.
- G. Pipe each gas relief vent to the outdoors, in accordance with the manufacturer's recommendations and the local codes.
- H. Contractor must, when filling the system, verify that the pH level is maintained between 6.0 and 8.5.
- I. Contractor to route condensate connection off of boiler and stack to acid neutralization kit and then to appropriate drain. Trap as required by boiler manufacturer.

3.2 BOILER MANUFACTURER STARTUP SERVICE

- A. Provide factory authorized startup services to assure its proper operation.
- B. Set the boiler operating and safety controls.
- C. Perform a flue gas analysis at the boiler outlet. Record the following results of the analysis:
 - 1. Carbon dioxide percent volume.
 - 2. Oxygen percent volume.

3. Stack temperature.
 4. Calculated combustion efficiency.
- D. Do not operate the boiler for any reason until the factory startup service has been completed.
 - E. Startup procedure shall include a functional test of Carbon Monoxide Detector. Simulate an alarm condition and demonstrate the functionality of the detector shutting down the appliances. Owner/Engineer shall be present to witness test.
 - F. Boiler shall not be operated without water treatment in the closed water loop.

END OF SECTION

SECTION 23 64 16 - CENTRIFUGAL LIQUID CHILLING MACHINE

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish and install a factory assembled, electric-driven, water-cooled, water chilling unit, with centrifugal compressor. Provide a packaged centrifugal water-cooled liquid chiller as specified with all controls and variable frequency drive necessary for automatic operation mounted on the machine.
- B. Section includes design, performance criteria, refrigerants, controls, and installation requirements for water-cooled magnetic bearing chillers.

1.2 RELATED WORK

- A. Division 23 Mechanical
 - 1. Chilled Water Piping
 - 2. Condenser Water Piping
 - 3. Vibration Isolation
 - 4. Controls
 - 5. Electrical Provisions of Mechanical Work
- B. Comply with applicable Standard/Codes of ARI 550/590, ANSI/ASHRAE 15, ANSI B31.5, ASME Section VIII, ASTM, NEMA, NEC, UL984, and OSHA as adopted by the State.

1.3 PERFORMANCE

- A. Furnish a unit with minimum capacity and characteristics as scheduled, allowing for 0.0001 fouling factor in the cooler and 0.00025 fouling factor in the condenser.

1.4 SUBMITTALS

- A. Submit manufacturer's certified computer generated performance and capacity data in accordance with specification requirements.
- B. Submit manufacturer's installation, start-up and service/maintenance instructions.
- C. Submit the following information:
 - 1. Manufacturer's installation instructions.
 - 2. Minimum Circuit Ampacity.
 - 3. Maximum Overcurrent Protection.
 - 4. Maximum conductor / Terminal Lug size.
 - 5. Minimum flow thru evaporator.
 - 6. Electrical interlocks.
- D. Submit recommended service clearance dimensions.
- E. Submit internal wiring diagram of Control Center.
- F. Submit product data on centrifugal chiller starter and harmonic filter.
- G. Submit AHRI certified performance data and energy consumption at design conditions and partial load operation of 25, 50, 75, and 100% loads with constant entering condenser water temperature at design conditions as specified.

- H. Submit a letter stating chiller being proposed meets the efficiency requirements of Centerpoint Energy's Score Program listed in Centerpoint Energy's Design Guide: HVAC Recommendations document.
- I. Submit shop drawings showing the placement of the water box connection after visiting the project. Match existing piping connections.
- J. Mark-up a copy of the specifications, indicating in the margin of each paragraph, the following: COMPLY, DO NOT COMPLY, NOT APPLICABLE.

1.4 DELIVERY/STORAGE/HANDLING

- A. Ship machine without initial charge of refrigerant and lubricating oil. The initial charge shall be supplied, shipped in containers and cylinders for field installation by the Manufacturer's service technician.
- B. All equipment and accessories shall be suitably boxed, crated, covered with a tarp, and protected internally and externally to prevent shipping damage and damage from the weather.
- C. Manufacturer shall provide quick shipment options to minimize product lead times.

1.6 WARRANTY

- A. The Chiller manufacturer shall provide a full machine parts, labor, and refrigerant warranty for a period of five (5) years from substantial completion.
 - 1. The warranty shall include, but not be limited to the compressor assemblies including motor, condensers, fans, variable frequency drives, controls, evaporator, condenser, refrigeration system and all other auxiliary components and accessories as well as refrigerant and oils in systems.
 - 2. In the event of failure, provide new or factory authorized rebuilt parts. Shop or job site rebuilt parts are not acceptable.
 - 3. On all manufacturers warranties the chiller manufacturer shall provide a factory certificate listing as a minimum chiller model, serial, and warranty information as specified above. Each chiller tag shall be provided with an individual and unique warranty certificate. Manufacturer's representative warranty letters are not acceptable as an alternative to the original manufacturer's certificates.
 - 4. The chiller manufacturer authorized service agency is required to perform any and all warranty service. Contractor warranty service is not authorized. Warranty work shall be performed with District Representative present.
- A. The Chiller manufacturer shall provide a compressor and motor parts only extended warranty for a total of 10 years.

1.7 PREVENTATIVE MAINTENANCE SERVICE AGREEMENT

- A. Furnish service and maintenance agreement of chillers for a period of 5 years from date of substantial completion. Include quarterly system examinations, required adjustments, and control calibrations. Repair/replace parts in accordance with manufacturer's recommendations. All work performed by manufacturer technicians. Maintenance agreement shall include the following items as a minimum:
 - a. Analyze compressor fault log (quarterly)
 - b. Check IGV operation (quarterly)
 - c. Check controls settings for proper configuration (quarterly)
 - d. Verify transducers and sensors for accuracy (quarterly)
 - e. Analyze controls log and faults (quarterly)

- f. Confirm correct water flow and pressure drop for both evaporator and condenser (quarterly)
- g. Evaluate the test/performance (quarterly)
- h. Leak test entire unit (quarterly)
- i. Check and record line voltage (quarterly)
- j. Inspect power components for signs of overheating (quarterly)
- k. Check and tighten all electrical components (annually)
- l. Perform moisture prevention (annually)
- m. Clean and leak test condenser tubes (annually)
- n. Clean the evaporator and condenser flow sensor (annually)

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Carrier
- B. Daikin
- B. Trane

2.2 HERMETIC MOTOR AND COMPRESSOR

- A. Multiple single stage compressors.
- B. Or single multi-stage high performance compressor.
- C. Motor, transmission and compressor hermetically sealed into a common assembly.
- D. Provide isolation valves to allow filter change with out removal of refrigerant charge.
- E. Variable Evaporator Flow Capability: All chillers shall be applied in variable evaporator flow (VPF) system and able to withstand a chilled water flow rate-of-change of twenty-five percent (25%) per minute while maintaining plus or minus two (+/- 2 F) of design supply chilled water temperature, and fifty percent (50%) per minute at any load above the compressor minimum without cycling "off" on low load (low leaving water temperature) or evaporator refrigerant temperature limit.
- F. Motors shall have winding RTD's for temperature sensing on each phase. Thermistors and thermal overloads are not acceptable. These temperatures shall be furnished to the unit control panel for monitoring and alarm.

2.4 LIQUID COOLER

- A. Cooler Components
 - 1. Shell-and-tube heat exchanger.
 - 2. Cleanable copper tubes with continuous 0.025-inch thickness from tube root to root.
 - 3. Removable heads.
 - 4. Nonferrous tubes and baffles for maximum corrosion resistance.
 - 5. Provide 150 psig working pressure water side construction.
 - 6. Provide 1.5 times the working pressure refrigerant side construction.
- B. Select the cooler with the fouling factor shown in the schedule.
- C. Provide grooved connections for water boxes.

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- D. Include pressure relief devices sized to meet the requirements of ASHRAE 15.
- E. The tubes shall be individually replaceable and secured to the intermediate supports without rolling or expanding to facilitate replacement if required.
- F. An electronic expansion valve shall control refrigerant flow to the evaporator.

2.5 WATER COOLED CONDENSER

- A. Condenser components:
 - 1. Shell-and-tube heat exchanger.
 - 2. Cleanable copper tubes with continuous 0.025-inch thickness from tube root to root.
 - 3. Removable heads.
 - 4. Seamless internally and externally enhanced copper tubes. Tubes shall be removable from both ends.
 - 5. Provide 150 psig working pressure water side construction.
 - 6. Provide 1.5 times the working pressure refrigerant side construction.
- B. Select the condenser with the fouling factor shown in the schedule.
- C. Grooved connections for piping connections.
- D. Pressure relief devices sized to meet the requirements of ASHRAE 15.
- E. The tubes shall be individually replaceable and secured to the intermediate supports without rolling or expanding to facilitate replacement if required.

2.6 PURGE UNIT

- A. High efficiency purge unit with positive means for collection and return of refrigerant, removal of noncondensables, water vapor and shall conform to requirements of ASHRAE 15. Provide indicating message on control panel of abnormal air leak or excessive purging. The purge unit shall be refrigerant cooled. Include operating controls, piping, and refrigerant service valves to isolate the purge unit from the chiller all factory installed. Purge unit shall automatically alarm (local and remote relay) if excess purging is detected.

2.7 REFRIGERANT RELIEF VALVE

- A. All chiller relief points shall be installed as required by the manufacturer and latest edition of ASHRAE 15.
- B. Provide chillers with reseating relief valves or rupture disks per ASHRAE standard 15.

2.8 POWER CONNECTIONS

- A. Power connection shall be single point to a factory-mounted disconnect switch.

2.9 CONTROLS AND INSTRUMENT PANEL

- A. Operation. For constant flow applications, automatically modulate the compressor through controls actuated by changes in the temperature of water leaving the chiller. For variable flow applications, modulate each compressor through changes in the temperature of water leaving the chiller. Start the compressors unloaded.

- B. Furnish a complete a microprocessor-based control system consisting of a 12.1-inch color LCD touch-screen operator interface and a unit controller that is factory mounted, wired, and tested. The touch-screen shall display the unit operating parameters, accept setpoint changes (multi-level password protected) and be capable of resetting faults and alarms. The following parameters shall be displayed on the home screen and also as trend curves on the trend screen:
1. Chilled water temperatures - supply and return.
 2. Condenser water temperatures - supply and return.
 3. Refrigerant pressures - evaporator and condenser.
 4. Motor current in % full load amps.
 5. Saturation temperatures - evaporator and condenser.
 6. Water flow indication.
 7. Oil temperature.
 8. Percent of capacity operation of compressor vanes position.
 9. Three phase volts and three phase amps.
 10. Elapsed time meter and number of compressor starts.
 11. Oil pressure at compressor.
 12. Alarm and failure messages.
 13. Diagnostics Service Log
 14. Motor winding temperature.
 15. Bearing oil temperature.
 16. Operating hours
 17. Number of starts
- C. In addition to the trended items above, all other important real-time operating parameters shall also be shown on the touch-screen. These items shall be displayed on a chiller graphic showing each component. At a minimum, the following set points must be monitored:
1. Chilled water supply temperature.
 2. Current limit.
 3. Pull down demand limit.
 4. Remote reset temperature range.
 5. Remote alarm contact.
 6. Compressor actual speed, maximum speed, percent speed
 7. Liquid line temperature
 8. Compressor and unit state and input and output digital and analog values
- Any input that potentially harms the machine shall be rejected and the operator shall be advised via display message. All system shutdowns (safety or cycling) shall be preserved (until the system is reset with pass-word or restarted) in the microcomputer's memory for subsequent viewing on the alphanumeric display. The operator shall be continuously advised of system operating conditions by various background and warning messages. The keypad shall contain special service passwords for use by service technicians when performing system troubleshooting.
- D. Safety controls shall be annunciated through the alphanumeric display consisting of day, time of shutdown, cause of shutdown, and type of restart required. Safety controls with automatic unit shutdown shall be provided for:
1. Sensor malfunction.
 2. High and low compressor oil pressure.
 3. High and low refrigerant pressure
 4. High compressor discharge temperature.
 5. Low evaporator pressure or high condenser pressure.
 6. Low chilled water temperature.
 7. High oil temperature.

8. Starter fault.
 9. Unit shall not start without minimum flow through the evaporator or the condenser.
 10. Clogged oil filter.
 11. Low oil pressure.
 12. Freeze protection.
 13. High discharge and low evaporator pressure cutout.
 14. Chilled water freeze protection.
 15. Loss of evaporator or condenser water flow.
 16. Phase loss, phase reversal, phase imbalance, and under or over voltage protection.
 17. Chilled water differential pressure switch to prove flow.
 18. Condenser water differential pressure switch to prove flow.
- E. Battery backup shall be provided to keep all Setpoints in memory for minimum of one month in case of power failure. Control Center shall provide for an automatic restart of chiller after a momentary power failure. Provide battery backup for all volatile memory setpoints.
1. Minimum of one month in case of power failure.
 2. Automatic battery recharging.
 3. Low battery charge alarm.
- F. Chilled water flow detection devices shall be provided to shut down unit when flow drops below minimum through evaporator or condenser.
- G. Security access shall be provided to prevent unauthorized change of Setpoints, reset failures and to allow local or remote control of the chiller.
- H. The Microcomputer Control Center shall provide interface that includes as a minimum:
1. Remote start.
 2. Remote stop.
 3. Remote leaving chilled water temperature setpoint and reset.
 4. Remote current limit setpoint.
 5. Ready to start status contact.
 6. Safety shutdown status contacts.
 7. Cycling shutdown status contacts.
 8. Compressor run relay contacts.
 9. Common alarm contact.
 10. Purge Alarm Relay
 11. Head Pressure Relief Relay
 12. Provide BacNET interface
 13. Alarm Relay
 14. Percent of Running Load Amperage
- I. Provide a relay control to signal the chilled and condenser water pumps. Provide a 30 second time delay between sequential ancillary equipment starts.
- J. Provide an "auto restart after power failure" control with manual reset for oil temperature low limit control.
- K. Provide controls to enable chiller to operate with 57 degree entering condenser water temperature.
- L. The factory supplied VFD and controls should include the following:
1. High short circuit panel rating of 65kA with a matching circuit breaker
 2. Phase loss protection

3. Under/over voltage protection
- M. Energy saving software logic shall at a minimum offer the following
 1. User programmable compressor soft loading
 2. Chilled water reset
 3. Demand limit control
 4. Staging options lead lag between multiple compressors on a single chiller or on multiple chillers
 5. Plotting of historic trends for optimizing efficiency

2.10 CAPACITY CONTROLS

- A. Solid state electronic.
- B. Fully automatic.
- C. Regulate chilled water temperature.
- D. Prevent motor overload by control of compressor guide vane positioner.
- E. Provide capacity modulation from 100% to 15% of full load under design conditions shown in the schedule. Provide chiller capable of operation without surge, cavitation, or undue vibration from full load to 15% load without hot gas bypass when supplied with design entering condenser water quantity. AHRI certified unloading report to be included in submittal.
- F. Provide leaving chilled water control within +/- 1.0°F (0.6°C) at a water flow rate change of 10% per minute and will stay online at a water flow rate change of 30% per minute.

2.11 SAFETY CONTROLS

- A. Electric/electronic and fully automatic.
- B. Fail-safe.
- C. Provide machine shutdown for:
 1. Low oil pressure.
 2. Low chilled water temperature.
 3. Low cooler pressure.
 4. High condenser pressure.
 5. High bearing oil temperature.
 6. High compressor discharge temperature.
 7. High motor winding temperature (hermetic machines).
- D. Insure thorough lubrication of compressor prior to start and during coast down after machine stop signal.
- E. Protect motor against drawing more than rated full load amperes.
- F. Prevent machine restart until after a safe pre-set time.
- G. Provide a demand limiter device so that maximum current can be set to any percentage between 40 and 100% of full load amperes.
- H. Surge capacitors and Lighting Arrestor.

- I. Provide factory-mounted and wired, differential pressure flow switches on each vessel to prevent unit operation with no or low water flow.

2.12 REMOTE MONITORING INSTRUMENTATION

- A. Provide non-energized auxiliary contacts for remote monitoring of chiller operating conditions extend wiring to identified terminal strip.
- B. Provide for normal system operation mode: Two normally open contacts.
- C. Provide for system safety shutdown mode: Two normally open contacts.
- D. Provide circuitry to allow remote discrimination between cycling and safety shutdown. Provide separate contact closure to indicate the chiller will start (all safeties and cycling devices satisfied) when a remote start signal is received.

2.13 REFRIGERANT

- A. Provide refrigerant type R-513a or R-514a as outlined in the project alternate bid Refrigerant shall comply with current ASHRAE Standard 15 and other governing authorities.

2.14 VIBRATION ISOLATION

- A. Provide with rubber isolation pads.

2.15 VARIABLE SPEED DRIVES

- A. A refrigerant cooled variable speed drive shall be factory supplied and installed on the chiller. It shall vary the compressor motor speed by controlling the frequency and voltage of the electrical power to the motor. The package shall include adaptive capacity control logic to automatically adjust the motor speed and compressor pre-rotation vane position independently. The control system shall provide maximum operating efficiency at all loads and water temperatures by analyzing information fed to it via sensors located throughout the chiller. Drive shall be PWM type utilizing IGBT's with a power factor of 0.95 or better at all loads and speeds. Drives that do not provide power factor correction are not acceptable.
 1. The variable speed drive shall be unit mounted in a NEMA-1 enclosure with all power and control wiring between the drive and the chiller factory installed, including the power to the chiller pump. Field power wiring shall be a single point connection and electrical lugs for incoming power wiring shall be provided. The entire chiller/drive package shall be UL listed. To minimize motor peak voltages to within acceptable motor insulation design limits, motor lead limits shall not exceed 18". The chiller/drive assembly shall undergo an electrical and mechanical run test prior to shipment.
 2. The following features shall be provided:
 - a. A door interlocked circuit breaker capable of being padlocked.
 - 1) UL listed ground fault protection.
 - 2) Over voltage and under voltage protection.
 - 3) 3 phase sensing motor overcurrent protection.
 - 4) Single phase protection.
 - 5) Insensitive to phase rotation.
 - 6) Over temperature protection.
 - 7) Digital readout at the chiller unit control panel of:
 - (a) Output Frequency
 - i. Output Voltage

- ii. 3 phase output current.
- (b) Input Kilowatts (kW) and Kilowatt-hours(kWh)
- i. Self diagnostic service parameters.

2.16 HARMONIC FILTER

- A. Provide factory unit Mounted harmonic filter that limits electrical power supply distortion to 5% TDD for current (5% TDD limits as defined by IEEE 519 specifications) from the variable speed drive. The filter shall be mounted in a NEMA -1 enclosure and shall be UL listed. The following digital readouts shall be provided at the chiller unit control panel as part of the filter package:
 - 1. Input KVA
 - a. Total power factor.
 - b. 3 phase input voltage
 - c. 3 phase input current
 - d. 3 phase input voltage total harmonic distortion (THD)
 - e. 3 phase input current total demand distortion (TDD)
 - f. Self diagnostic service parameters
 - 2. AHRI certified chiller performance shall take into account energy losses due to harmonic filtration.

PART 3 - EXECUTION

3.1 HANDLING & INSTALLATION

- A. Install new chiller and align new chiller on concrete foundations, sole plates and sub-bases. Adjust and level chiller in alignment on supports and grout in place.
- B. Provide neoprene vibration isolation bonded to steel.
- C. Install the system in accordance with the manufacturer's installation instructions.
- D. Arrange piping for easy dismantling to permit tube cleaning and service.
- E. Pipe the chiller rupture disc to outdoors; size discharge piping as recommended by the chiller manufacturer.
- F. Install condenser water modulating valve and controls to enable chiller to operate with 40 degree entering condenser water temperature.
- G. Coordinate electrical installation with the electrical contractor.
- H. Coordinate controls with the control contractor.
- I. Provide all appurtenances required to ensure a fully operational and functional chiller.
- J. Prior to chiller start-up, verify that the water treatment equipment has been properly installed and is in working condition. Do not operate the equipment for any reason until the complete circulating condenser water chemical treatment system is operational as specified.
- K. Do not install paddle flow switches. Wet DP switches only. DP switches shall be installed per manufacturers recommendations.
- L. Do not operate the equipment for any reason until the complete circulating condenser water temperature controls are operational.

- M. All electrical conduits shall be connected to chiller in the bottom of electrical cabinet. Top and side connections are not acceptable.

3.2 INSULATION (FIELD APPLIED)

- A. Field applied after installation prior to start-up.
- B. Flexible closed cell foam. Two 3/4" layers, overlapping seams of the first layer.
- C. Apply insulation, vapor proof cement and enamel paint (color to match chiller) to:
 - 1. Cooler shell.
 - 2. Float chamber.
 - 3. End sheets.
 - 4. Waterboxes
 - 4. Suction connection.
 - 5. Motor cooling connection (hermetic machines).
 - 6. Necessary auxiliary tubing.
 - 7. Other components subject to surface condensation.
- D. Resistant Coating
 - 1. WB Armaflex Finish
 - 2. Apply weather protective finish on elastomeric insulation. Provide a minimum of three coats.
 - 3. Color to match chiller manufacturer's equipment.

3.3 CHILLER MANUFACTURER START-UP SERVICE

- A. Provide the services of a factory trained service technician employed full time by the chiller manufacturer to start-up the system. Technicians, as required, shall be trained and experienced in the work they perform. (Contractor startup is unacceptable.) Sample forms shall be submitted for approval before starting work.
- B. The technician shall utilize comprehensive report forms to document results. Sample forms shall be submitted for review prior to commencing work.
- C. Upon completion of the work, the report forms shall be signed by the technician and included in the final report and Owner's manual.
- D. Submit four copies of the final report to the Architect/Engineer within 10 working days of start-up.
- E. Follow the manufacturer's start-up procedures.
 - 1. Verify interlocks.
 - 2. Test and verify operation of safety controls.
 - 3. Calibrate controls.
 - 4. Verify microprocessor based control operation.
 - 5. Test, calibrate, and set the chilled water temperature controls.
 - 6. Verify chilled water temperature reset sequence.
 - 7. Verify operation of the integrated control panel.
 - 8. Verify correct interface between Building Management Control System and chiller control panel.
- F. Measure and record the following data:
 - 1. Chilled and condenser water entering/leaving temperature.
 - 2. Chilled and condenser water flow through the chiller.

3. Suction pressure/condensing pressure.
 4. Suction pressure/unloading steps.
 5. Air entering/leaving cooling tower wet / dry bulb temperature.
 6. Outdoor ambient; wet / dry bulb.
 7. Motor nameplate voltage; phase and full load amperes.
 8. Heater coil in starter (as applicable)
 - a. Rating in amperes.
 - b. Manufacturer's recommendation.
 9. Power reading (voltage and amperes of legs at motor terminals).
- G. Test and calibrate the operation of the electronic ground current sensing devices.
- H. Measure the chiller control signal. Compare to the manufacturer's instructions. Calibrate and adjust the signal through all stages of operation.
- I. If the system has been shipped with a holding charge:
 1. Leak test.
 2. Refrigerant pressure test.
 3. Evacuate, dehydrate and charge.
- J. Verify that accessories are installed and performing the specified functions. Insert certification in Owner's manual.
- K. Instruct the Owner's operating personnel. Provide Owner with 8 hours of training prior to substantial completion after a complete startup procedure.
- L. Do not operate the equipment for any reason until the factory start-up service has been completed.
- M. Provide a printout from the unit microcomputer control system showing the correct operation of all system controls and components.
- N. Do not operate the equipment for any reason until the complete circulating condenser water chemical treatment system is operational as specified.

3.4 TRAINING

- A. The manufacturer shall provide, as part of their proposal, training two Owner representatives for a two-day training session.
- B. Training shall include hands on and classroom type training which pertains to the purchased equipment. The training shall give the trainees the ability to completely tear down and overhaul the purchased equipment. Any and all literature, manual or information shall be given to the trainees.

3.5 ADDITIONAL REQUIREMENTS

- A. The manufacturer is to supply two complete sets of maintenance manuals for the chiller. The manual should be a complete overhaul and maintenance manual. Detailed drawings of all internal parts and complete parts list shall be provided with the chillers.

3.6 FACTORY CERTIFIED TESTING

- A. Certified Capacity Testing
 1. Test each chiller at a test facility certified by AHRI.
 2. Perform certified tests in accordance with the current edition of AHRI Standard 550.

3. Chiller shall deliver at minimum the specified cooling capacity at design conditions and the maximum KW/ton shall not exceed 105% of the specified values.
 4. The test shall include computations for adjusted test results to reflect the fouling factors as specified.
 5. Completed test results for each chiller shall be submitted to the Engineer, certifying the design capacity and Maximum KW/ton at the design point.
 6. The test results shall be certified by an officer of the Manufacturer.
 7. If chiller fails to meet the scheduled capacity, the manufacturer shall revise the equipment to achieve the scheduled capacity requirements and conduct a new test after revisions to the equipment are made.
- B. Certified Tube Thickness Testing
1. Perform certified eddy current testing on all tubes both the condenser and evaporator to certify tube thickness meets or exceed the specified thickness value from root to root. Provide certified report of testing to owner to use as a baseline for comparison to future testing.

3.7 LIFE CYCLE COST ANALYSIS

- A. Manufacturer to provide efficiencies at the following four points to allow for an energy analysis to be performed by the engineer:
1. A= KW/ton @ 95% load and 82.0 degrees ECWT (41%)
 2. B= KW/ton @ 75% load and 76.8 degrees ECWT (40%)
 3. C= KW/ton @ 50% load and 74.1 degrees ECWT (16%)
 4. D= KW/ton @ 25% load and 62.8 degrees ECWT (3%)

END OF SECTION

SECTION 23 64 17 - MAGNETIC BEARING CENTRIFUGAL LIQUID CHILLING MACHINE

PART 1 – GENERAL

1.1 WORK INCLUDED

- A. Provide a packaged, electric-driven, water-cooled, water chilling unit, with oil-free, magnetic bearing, semi-hermetic centrifugal compressor with all controls and starter necessary for automatic operation mounted on the machine.
- B. Section includes design, performance criteria, refrigerants, controls, and installation requirements for water-cooled magnetic bearing chillers.

1.2 RELATED WORK

- A. Division 23 Mechanical
 - 1. Chilled Water Piping
 - 2. Condenser Water Piping
 - 3. Vibration Isolation
 - 4. Controls
 - 5. Electrical Provisions of Mechanical Work
- B. Comply with applicable Standard/Codes of ARI 550/590, ANSI/ASHRAE 15, ANSI B31.5, ASME Section VIII, ASTM, NEMA, NEC, UL984, and OSHA as adopted by the State.

1.3 PERFORMANCE

- A. Furnish a unit with minimum capacity and characteristics as scheduled, allowing for 0.0001 fouling factor in the cooler and 0.00025 fouling factor in the condenser.

1.4 SUBMITTALS

- A. Submit manufacturer's certified computer generated performance and capacity data in accordance with specification requirements.
- B. Submit manufacturer's installation, start-up and service/maintenance instructions.
- C. Submit the following information:
 - 1. Manufacturer's installation instructions.
 - 2. Minimum Circuit Ampacity.
 - 3. Maximum Overcurrent Protection.
 - 4. Maximum conductor / Terminal Lug size.
 - 5. Minimum flow thru evaporator.
 - 6. Electrical interlocks.
- D. Submit recommended service clearance dimensions.
- E. Submit internal wiring diagram of Control Center.
- F. Submit product data on centrifugal chiller starter and harmonic filter.
- G. Submit AHRI certified performance data and energy consumption at design conditions and partial load operation of 25, 50, 75, and 100% loads with constant entering condenser water temperature at design conditions as specified.

- H. Submit a letter stating chiller being proposed meets the efficiency requirements of Centerpoint Energy's Score Program listed in Centerpoint Energy's Design Guide: HVAC Recommendations document.
- I. Submit shop drawings showing the placement of the water box connection after visiting the project. Match existing piping connections.
- J. Mark-up a copy of the specifications, indicating in the margin of each paragraph, the following: COMPLY, DO NOT COMPLY, NOT APPLICABLE.

1.5 DELIVERY/STORAGE/HANDLING

- A. Ship machine without initial charge of refrigerant and lubricating oil. The initial charge shall be supplied, shipped in containers and cylinders for field installation by the Manufacturer's service technician.
- B. All equipment and accessories shall be suitably boxed, crated, covered with a tarp, and protected internally and externally to prevent shipping damage and damage from the weather.
- C. Manufacturer shall provide quick shipment options to minimize product lead times.

1.6 WARRANTY

- A. The Chiller manufacturer shall provide a full machine parts, labor, and refrigerant warranty for a period of five (5) years from substantial completion.
 - 1. The warranty shall include, but not be limited to the compressor assemblies including motor, condensers, fans, variable frequency drives, controls, evaporator, condenser, refrigeration system and all other auxiliary components and accessories as well as refrigerant and oils in systems.
 - 2. In the event of failure, provide new or factory authorized rebuilt parts. Shop or job site rebuilt parts are not acceptable.
 - 3. On all manufacturers warranties the chiller manufacturer shall provide a factory certificate listing as a minimum chiller model, serial, and warranty information as specified above. Each chiller tag shall be provided with an individual and unique warranty certificate. Manufacturer's representative warranty letters are not acceptable as an alternative to the original manufacturer's certificates.
 - 4. The chiller manufacturer authorized service agency is required to perform any and all warranty service. Contractor warranty service is not authorized. Warranty work shall be performed with District Representative present.
- C. The Chiller manufacturer shall provide a compressor and motor parts only extended warranty for a total of 10 years.

1.7 PREVENTATIVE MAINTENANCE SERVICE AGREEMENT

- A. Furnish service and maintenance agreement of chillers for a period of 5 years from date of substantial completion. Include quarterly system examinations, required adjustments, and control calibrations. Repair/replace parts in accordance with manufacturer's recommendations. All work performed by manufacturer technicians. Maintenance agreement shall include the following items as a minimum:
 - a. Analyze compressor fault log (quarterly)
 - b. Check IGV operation (quarterly)
 - c. Check controls settings for proper configuration (quarterly)
 - d. Verify transducers and sensors for accuracy (quarterly)

- e. Analyze controls log and faults (quarterly)
- f. Confirm correct water flow and pressure drop for both evaporator and condenser (quarterly)
- g. Evaluate the test/performance (quarterly)
- h. Leak test entire unit (quarterly)
- i. Check and record line voltage (quarterly)
- j. Inspect power components for signs of overheating (quarterly)
- k. Check and tighten all electrical components (annually)
- l. Perform moisture prevention (annually)
- m. Clean and leak test condenser tubes (annually)
- n. Clean the evaporator and condenser flow sensor (annually)

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Daikin

2.2 SEMI-HERMETIC MOTOR AND COMPRESSOR

- A. The unit shall utilize magnetic bearing, oil-free, semi-hermetic centrifugal compressors. The levitated shaft position shall be digitally controlled and shall be monitored by X-axis position sensor, Y-axis position sensor, and Z-axis position sensor. The compressor drive train shall be capable of coming to a controlled, safe stop in the event of a power failure by diverting stored power to the magnetic bearing controls system.
- B. The motor shall be of the semi-hermetic type, of sufficient size to efficiently fulfill compressor horsepower requirements. It shall be liquid refrigerant cooled with internal thermal sensing devices in the stator windings. The motor shall be compatible with variable frequency drive operation.
- C. The chiller shall be equipped with an integrated Variable Frequency Drive (VFD) to automatically regulate compressor speed in response to cooling load and the compressor pressure lift requirement. Movable inlet guide vanes and variable compressor speed acting together, shall provide unloading. The chiller controls shall coordinate compressor speed and guide vane position to optimize chiller efficiency.
- D. Each compressor circuit shall be equipped with a 5% rated line reactor to help protect against incoming power surges and help reduce harmonic distortion.
- E. The unit shall have a minimum of a 0.90 power factor at compressor full load.
- F. Variable Evaporator Flow Capability: All chillers shall be applied in variable evaporator flow (VPF) system and able to withstand a chilled water flow rate-of-change of twenty-five percent (25%) per minute while maintaining plus or minus two (+/- 2 F) of design supply chilled water temperature, and fifty percent (50%) per minute at any load above the compressor minimum without cycling "off" on low load (low leaving water temperature) or evaporator refrigerant temperature limit.
- G. Motors shall have winding RTD's for temperature sensing on each phase. Thermistors and thermal overloads are not acceptable. These temperatures shall be furnished to the unit control panel for monitoring and alarm.

2.3 LIQUID COOLER

- A. Cooler Components
 - 1. Shell-and-tube heat exchanger.
 - 2. Cleanable copper tubes with continuous 0.025 inch thickness from tube root to root.
 - 3. Removable heads.
 - 4. Nonferrous tubes and baffles for maximum corrosion resistance.
 - 5. Provide 150 psig working pressure water side construction.
 - 6. Provide 200 psig working pressure refrigerant side construction.
- B. Select the cooler with the fouling factor shown in the schedule.
- C. Provide grooved connections for water boxes.
- D. Include pressure relief devices sized to meet the requirements of ASHRAE 15.
- E. The tubes shall be individually replaceable and secured to the intermediate supports without rolling or expanding to facilitate replacement if required.
- F. An electronic expansion valve shall control refrigerant flow to the evaporator.

2.4 WATER COOLED CONDENSER

- A. Condenser components:
 - 1. Shell-and-tube heat exchanger.
 - 2. Cleanable copper tubes with continuous 0.025-inch thickness from tube root to root.
 - 3. Removable heads.
 - 4. Seamless integral finned copper tubes.
 - 5. Provide 150 psig working pressure water side construction.
 - 6. Provide 200 psig working pressure refrigerant side construction.
- B. Select the condenser with the fouling factor shown in the schedule.
- C. Grooved connections for water boxes.
- D. Pressure relief devices sized to meet the requirements of ASHRAE 15.
- E. The tubes shall be individually replaceable and secured to the intermediate supports without rolling or expanding to facilitate replacement if required.

2.5 REFRIGERANT RELIEF VALVE

- A. All chiller relief points shall be installed as required by the manufacturer and latest edition of ASHRAE 15.
- B. Provide chillers with reseating relief valves or rupture disks per ASHRAE standard 15.

2.6 REFRIGERANT ISOLATION

- A. Provide unit with manually operated isolation valves located at the inlet and outlet of the condenser. Condenser shall be able to store the entire system refrigerant charge during servicing. Provide service valves to facilitate removal of the refrigerant from the system. Check valves are not approved for isolation. If isolation valves cannot be provided, the chiller manufacturer shall provide a separate refrigerant transfer/storage unit to hold one chillers full refrigerant charge when 90% full.

2.7 POWER CONNECTIONS

- A. Power connection shall be single point to a factory-mounted disconnect switch.

2.8 CONTROLS AND INSTRUMENT PANEL

- A. Operation. For constant flow applications, automatically modulate the compressor through controls actuated by changes in the temperature of water leaving the chiller. For variable flow applications, modulate each compressor through changes in the temperature of water leaving the chiller. Start the compressors unloaded.
- B. Furnish a complete a microprocessor-based control system consisting of a 15-inch VGA touch-screen operator interface and a unit controller that is factory mounted, wired, and tested. The touch-screen shall display the unit operating parameters, accept setpoint changes (multi-level password protected) and be capable of resetting faults and alarms. The following parameters shall be displayed on the home screen and also as trend curves on the trend screen:
 - 1. Chilled water temperatures - supply and return.
 - 2. Condenser water temperatures - supply and return.
 - 3. Refrigerant pressures - evaporator and condenser.
 - 4. Motor current in % full load amps.
 - 5. Saturation temperatures - evaporator and condenser.
 - 6. Water flow indication.
 - 7. Oil temperature.
 - 8. Percent of capacity operation of compressor vanes position.
 - 9. Three phase volts and three phase amps.
 - 10. Elapsed time meter and number of compressor starts.
 - 11. Oil pressure at compressor.
 - 12. Alarm and failure messages.
 - 13. Diagnostics Service Log
 - 14. Motor winding temperature on hermetic units only.
 - 15. Bearing oil temperature.
 - 16. Operating hours
 - 17. Number of starts
- C. In addition to the trended items above, all other important real-time operating parameters shall also be shown on the touch-screen. These items shall be displayed on a chiller graphic showing each component. At a minimum, the following set points must be monitored:
 - 1. Chilled water supply temperature.
 - 2. Current limit.
 - 3. Pull down demand limit.
 - 4. Remote reset temperature range.
 - 5. Remote alarm contact.
 - 6. Compressor actual speed, maximum speed, percent speed
 - 7. Liquid line temperature
 - 8. Compressor and unit state and input and output digital and analog values: Any input that potentially harms the machine shall be rejected and the operator shall be advised via display message. All system shutdowns (safety or cycling) shall be preserved (until the system is reset with password or restarted) in the microcomputer's memory for subsequent viewing on the alphanumeric display. The operator shall be continuously advised of system operating conditions by various background and warning messages. The keypad shall contain special service passwords for use by service technicians when performing system

troubleshooting.

- D. Safety controls shall be annunciated through the touch-screen display consisting of day, time of shutdown, cause of shutdown, and type of restart required. Safety controls with automatic unit shutdown shall be provided for:
1. Sensor malfunction.
 2. High and low compressor oil pressure.
 3. High and low refrigerant pressure
 4. High compressor discharge temperature.
 5. Low evaporator pressure or high condenser pressure.
 6. Low chilled water temperature.
 7. High oil temperature.
 8. Starter fault.
 9. Unit shall not start without minimum flow through the evaporator or the condenser.
 10. Clogged oil filter.
 11. Low oil pressure.
 12. Freeze protection.
 13. High discharge and low evaporator pressure cutout.
 14. Chilled water freeze protection.
 15. Loss of evaporator or condenser water flow.
 16. Phase loss, phase reversal, phase imbalance, and under or over voltage protection.
 17. Chilled water differential pressure switch to prove flow.
 18. Condenser water differential pressure switch to prove flow.
- E. Battery backup shall be provided to keep all Setpoints in memory for minimum of one month in case of power failure. Control Center shall provide for an automatic restart of chiller after a momentary power failure. Provide battery backup for all volatile memory setpoints.
1. Minimum of one month in case of power failure.
 2. Automatic battery recharging.
 3. Low battery charge alarm.
- F. Chilled water flow detection devices shall be provided to shut down unit when flow drops below minimum through evaporator or condenser.
- G. Security access shall be provided to prevent unauthorized change of Setpoints, reset failures and to allow local or remote control of the chiller.
- H. The Microcomputer Control Center shall provide interface that includes as a minimum:
1. Remote start.
 2. Remote stop.
 3. Remote leaving chilled water temperature setpoint and reset.
 4. Remote current limit setpoint.
 5. Ready to start status contact.
 6. Safety shutdown status contacts.
 7. Cycling shutdown status contacts.
 8. Compressor run relay contacts.
 9. Common alarm contact.
 10. Purge Alarm Relay
 11. Head Pressure Relief Relay
 12. Provide BacNET interface
 13. Alarm Relay
 14. Percent of Running Load Amperage

- I. Provide a relay control to signal the chilled and condenser water pumps and cooling tower. Provide a 30 second time delay between sequential ancillary equipment starts.
- J. Provide an "auto restart after power failure" control with manual reset for oil temperature low limit control.
- K. Power factor correction capacitors resulting full load power factor to 95%. Provide non-PCB unit with discharge resistor. PFCC shall be factory mounted and wired by the chiller manufacturer.
- L. Provide valves and controls to enable chiller to operate with 40 degree entering condenser water temperature.
- M. The factory supplied VFD and controls should include the following:
 - 1. High short circuit panel rating of 35kA with a matching circuit breaker
 - 2. Phase loss protection
 - 3. Under/over voltage protection
- N. Energy saving software logic shall at a minimum offer the following
 - 1. User programmable compressor soft loading
 - 2. Chilled water reset
 - 3. Demand limit control
 - 4. Staging options lead lag between multiple compressors on a single chiller or on multiple chillers
 - 5. Plotting of historic trends for optimizing efficiency

2.9 CAPACITY CONTROLS

- A. Solid state electronic.
- B. Fully automatic.
- C. Regulate chilled water temperature.
- D. Prevent motor overload by control of compressor guide vane positioner.
- E. Provide capacity modulation from 100% to 15% of full load under design conditions shown in the schedule. Provide chiller capable of operation without surge, cavitation, or undue vibration from full load to 15% load without hot gas bypass when supplied with design entering condenser water quantity. AHRI certified unloading report to be included in submittal.
- F. Provide leaving chilled water control within +/- 1.0°F (0.6°C) at a water flow rate change of 10% per minute and will stay online at a water flow rate change of 30% per minute.

2.10 SAFETY CONTROLS

- A. Electric/electronic and fully automatic.
- B. Fail-safe.
- C. Provide machine shutdown for:
 - 1. Low oil pressure.
 - 2. Low chilled water temperature.

3. Low cooler pressure.
 4. High condenser pressure.
 5. High bearing oil temperature.
 6. High compressor discharge temperature.
 7. High motor winding temperature (hermetic machines).
- D. Insure thorough lubrication of compressor prior to start and during coast down after machine stop signal.
 - E. Protect motor against drawing more than rated full load amperes.
 - F. Prevent machine restart until after a safe pre-set time.
 - G. Provide a demand limiter device so that maximum current can be set to any percentage between 40 and 100% of full load amperes.
 - H. Surge capacitors and Lighting Arrestor
 - I. Provide factory-mounted and wired, thermal-dispersion water flow switches on each vessel to prevent unit operation with no or low water flow.

2.11 REMOTE MONITORING INSTRUMENTATION

- A. Provide non-energized auxiliary contacts for remote monitoring of chiller operating conditions extend wiring to identified terminal strip.
- B. Provide for normal system operation mode: Two normally open contacts.
- C. Provide for system safety shutdown mode: Two normally open contacts.
- D. Provide circuitry to allow remote discrimination between cycling and safety shutdown. Provide separate contact closure to indicate the chiller will start (all safeties and cycling devices satisfied) when a remote start signal is received.

2.12 REFRIGERANT

- A. Provide refrigerant type HFC-134A.,or HCFC-123. Refrigerant shall comply with current ASHRAE Standard 15 and other governing authorities.

2.13 VIBRATION ISOLATION

- A. Provide with rubber isolation pads.

2.14 VARIABLE SPEED DRIVES

- A. A refrigerant cooled variable speed drive shall be factory installed on the chiller. It shall vary the compressor motor speed by controlling the frequency and voltage of the electrical power to the motor. The package shall include adaptive capacity control logic to automatically adjust the motor speed and compressor pre-rotation vane position independently. The control system shall provide maximum operating efficiency at all loads and water temperatures by analyzing information fed to it via sensors located throughout the chiller. Drive shall be PWM type utilizing IGBT's with a power factor of 0.95 or better at all loads and speeds. Drives that do not provide power factor correction are not acceptable.
 1. The variable speed drive shall be unit mounted in a NEMA-1 enclosure with all

power and control wiring between the drive and the chiller factory installed, including the power to the chiller pump. Field power wiring shall be a single point connection and electrical lugs for incoming power wiring shall be provided. The entire chiller/drive package shall be UL listed. To minimize motor peak voltages to within acceptable motor insulation design limits, motor lead limits shall not exceed 18". The chiller/drive assembly shall undergo an electrical and mechanical run test prior to shipment. Water cooled drives are not acceptable.

2. The following features shall be provided:
 - a. A door interlocked circuit breaker capable of being padlocked.
 - 1) UL listed ground fault protection.
 - 2) Over voltage and under voltage protection.
 - 3) 3 phase sensing motor overcurrent protection.
 - 4) Single phase protection.
 - 5) Insensitive to phase rotation.
 - 6) Over temperature protection.
 - 7) Digital readout at the chiller unit control panel of:
 - a) Output Frequency
 - (1) Output Voltage
 - (2) 3 phase output current.
 - b) Input Kilowatts (kW) and Kilowatt-hours(kWh)
 - (1) Self-diagnostic service parameters.

2.15 HARMONIC FILTER

- A. Provide factory unit Mounted harmonic filter that limits electrical power supply distortion to 5% TDD for current (5% TDD limits as defined by IEEE 519 specifications) from the variable speed drive. The filter shall be mounted in a NEMA -1 enclosure and shall be UL listed. The following digital readouts shall be provided at the chiller unit control panel as part of the filter package:
 1. Input KVA
 - a. Total power factor.
 - b. 3 phase input voltage
 - c. 3 phase input current
 - d. 3 phase input voltage total harmonic distortion (THD)
 - e. 3 phase input current total demand distortion (TDD)
 - f. Self diagnostic service parameters
 2. AHRI certified chiller performance shall take into account energy losses due to harmonic filtration.

PART 3 - EXECUTION

3.1 HANDLING & INSTALLATION

- A. Install new chiller and align new chiller on concrete foundations, sole plates and sub-bases. Adjust and level chiller in alignment on supports and grout in place.
- B. Provide neoprene vibration isolation bonded to steel.
- C. Install the system in accordance with the manufacturer's installation instructions.
- D. Arrange piping for easy dismantling to permit tube cleaning and service.
- E. Pipe the chiller rupture disc to outdoors; size discharge piping as recommended by the chiller manufacturer.
- F. Install condenser water modulating valve and controls to enable chiller to operate with 40

degree entering condenser water temperature.

- G. Coordinate electrical installation with the electrical contractor.
- H. Coordinate controls with the control contractor.
- I. Provide all appurtenances required to ensure a fully operational and functional chiller.
- J. Prior to chiller start-up, verify that the water treatment equipment has been properly installed and is in working condition. Do not operate the equipment for any reason until the complete circulating condenser water chemical treatment system is operational as specified.
- K. Do not install paddle flow switches. Wet DP switches only. DP switches shall be installed per manufacturers recommendations.
- L. Do not operate the equipment for any reason until the complete circulating condenser water temperature controls are operational.
- M. All electrical conduits shall be connected to chiller in the bottom of electrical cabinet. Top and side connections are not acceptable.

3.2 INSULATION (FIELD APPLIED)

- A. Field applied after installation prior to start-up.
- B. Flexible closed cell foam. Two 3/4" layers, overlapping seams of the first layer.
- C. Apply insulation, vapor proof cement and enamel paint (color to match chiller) to:
 - 1. Cooler shell.
 - 2. Float chamber.
 - 3. End sheets.
 - 4. Waterboxes
 - 5. Suction connection.
 - 6. Motor cooling connection (hermetic machines).
 - 7. Necessary auxiliary tubing.
 - 8. Other components subject to surface condensation.
- D. Resistant Coating
 - 1. WB Armaflex Finish
 - 2. Apply weather protective finish on elastomeric insulation. Provide a minimum of three coats.
 - 3. Color to match chiller manufacturer's equipment.

3.3 CHILLER MANUFACTURER START-UP SERVICE

- A. Provide the services of a factory trained service technician employed full time by the chiller manufacturer to start-up the system. Technicians, as required, shall be trained and experienced in the work they perform. (Contractor startup is unacceptable.)
- B. The technician shall utilize comprehensive report forms to document results. Sample forms shall be submitted for review prior to commencing work.
- C. Upon completion of the work, the report forms shall be signed by the technician and included in the final report and Owner's manual.

- D. Submit four copies of the final report to the Architect/Engineer within 10 working days of start-up.
- E. Follow the manufacturer's start-up procedures.
 - 1. Verify interlocks.
 - 2. Test and verify operation of safety controls.
 - 3. Calibrate controls.
 - 4. Verify microprocessor based control operation.
 - 5. Test, calibrate, and set the chilled water temperature controls.
 - 6. Verify chilled water temperature reset sequence.
 - 7. Verify operation of the integrated control panel.
 - 8. Verify correct interface between Building Management Control System and chiller control panel.
- F. Measure and record the following data:
 - 1. Chilled and condenser water entering/leaving temperature.
 - 2. Chilled and condenser water flow through the chiller.
 - 3. Suction pressure/condensing pressure.
 - 4. Suction pressure/unloading steps.
 - 5. Air entering/leaving cooling tower wet / dry bulb temperature.
 - 6. Outdoor ambient; wet / dry bulb.
 - 7. Motor nameplate voltage; phase and full load amperes.
 - 8. Heater coil in starter (as applicable)
 - a. Rating in amperes.
 - b. Manufacturer's recommendation.
 - 9. Power reading (voltage and amperes of legs at motor terminals).
- G. Test and calibrate the operation of the electronic ground current sensing devices.
- H. If the system has been shipped with a holding charge:
 - 1. Leak test.
 - 2. Refrigerant pressure test.
 - 3. Evacuate, dehydrate and charge.
- I. Verify that accessories are installed and performing the specified functions. Insert certification in Owner's manual.
- J. Instruct the Owner's operating personnel. Provide Owner with 8 hours of training prior to substantial completion after a complete startup procedure.
- K. Do not operate the equipment for any reason until the factory start-up service has been completed.
- L. Provide a printout from the unit microcomputer control system showing the correct operation of all system controls and components.
- M. Do not operate the equipment for any reason until the complete circulating condenser water chemical treatment system is operational as specified.
- N. Do not operate the equipment for any reason until the complete circulating condenser water temperature controls are operational under Section 23 09 33 as specified.

3.4 TRAINING

- A. The manufacturer shall provide, as part of their proposal, training two Owner representatives for a two-day training session.
- B. Training shall include hands on and classroom type training which pertains to the purchased equipment. The training shall give the trainees the ability to completely tear down and overhaul the purchased equipment. Any and all literature, manual or information shall be given to the trainees.

3.5 ADDITIONAL REQUIREMENTS

- A. The manufacturer shall provide and deliver to the owner the following spare equipment and parts prior to acceptance of the liquid chillers.
- B. The manufacturer is to supply two complete sets of maintenance manuals for the chiller. The manual should be a complete overhaul and maintenance manual. Detailed drawings of all internal parts and complete parts list shall be provided with the chillers.

3.6 FACTORY CERTIFIED TESTING

- A. Certified Capacity Testing
 1. Test each chiller at a test facility certified by AHRI.
 2. Perform certified tests in accordance with the current edition of AHRI Standard 550.
 3. Chiller shall deliver at minimum the specified cooling capacity at design conditions and the maximum KW/ton shall not exceed 105% of the specified values.
 4. The test shall include computations for adjusted test results to reflect the fouling factors as specified.
 5. Completed test results for each chiller shall be submitted to the Engineer, certifying the design capacity and Maximum KW/ton at the design point.
 6. The test results shall be certified by an officer of the Manufacturer.
 7. If chiller fails to meet the scheduled capacity, the manufacturer shall revise the equipment to achieve the scheduled capacity requirements and conduct a new test after revisions to the equipment are made.
- B. Certified Tube Thickness Testing
 1. Perform certified eddy current testing on all tubes both the condenser and evaporator to certify tube thickness meets or exceed the specified thickness value from root to root. Provide certified report of testing to owner to use as a baseline for comparison to future testing.

3.7 LIFE CYCLE COST ANALYSIS

- A. Manufacturer to provide efficiencies at the following four points to allow for an energy analysis to be performed by the engineer:
 1. A= KW/ton @ 95% load and 82.0 degrees ECWT (41%)
 2. B= KW/ton @ 75% load and 76.8 degrees ECWT (40%)
 3. C= KW/ton @ 50% load and 74.1 degrees ECWT (16%)
 4. D= KW/ton @ 25% load and 62.8 degrees ECWT (3%)

END OF SECTION

SECTION 23 65 41 - PACKAGED STEEL COOLING TOWER

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish and install a packaged stainless steel cooling tower as shown on the drawings with the following characteristics.
 - 1. Two or three cell as indicated
 - 2. Induced draft
 - 3. Vertical discharge
 - 4. Counterflow Only

1.2 RELATED WORK

- A. Division 23 Mechanical
 - 1. Condenser water piping
 - 2. Building Management Control System
 - 3. Chemical treatment
 - 4. Electrical Provisions for Mechanical Work
 - 5. Valves

1.3 PERFORMANCE

- A. Provide performance as scheduled on Drawings. Certify in accordance with the standards of the cooling tower institute.
- B. Sound levels and safety features shall be in compliance with latest OSHA requirements.
 - 1. Sound levels shall not exceed 71 dB at approximately 50 feet from tower and a minimum of 57 dB at all property lines.
 - 2. Provide low sound fans and all other low noise tower options to meet previous mentioned sound levels.
 - 3. Sound levels shall be independently verified by a CTI-licensed sound test agency to ensure validity and reliability of the manufacturers published values. Measurement and analysis of the sound levels shall be conducted by a certified Professional Engineer in Acoustical Engineering. Sound pressure levels shall be measured and recorded in the acoustic near-field and far-field locations using ANSI S1.4 Type 1 precision instrumentation and in full conformance with CTI ATC-128 test code published by the Cooling Technology Institute (CTI). All low sound options shall be CTI certified for thermal performance.

1.4 SUBMITTAL

- A. Shop drawing submittal includes, but is not limited to the following:
 - 1. Manufacturer's certified capacity curve with selections plotted
 - 2. Shop drawings and product data
 - 3. Foundation requirements and operating weights
 - 4. Manufacturer's installation, start-up and service instructions
 - 5. Submit a chart of specific sound power level at each octave band center frequency.

1.5 WARRANTY

- A. The tower manufacturer shall provide a full machine parts and labor warranty for a period of one (1) year. Warranty shall begin at substantial completion. Provide manufacturer's warranty certificates as described below.

- B. The tower manufacturer shall an extended warranty as follows; 5 years parts on exterior shell, 2 years on the water distribution system and rotary spray nozzles, motors, fan assembly and water collection system.

1.6 DELIVERY OPTIONS

- A. Manufacturer shall provide quick shipment options to minimize product lead times.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Marley
- B. Evapco

2.2 UNIT HOUSING

- A. Construct the unit housing and internal supports of no less than 14 gauge Type 304 stainless steel.
- B. Cold water basin shall be fully welded Type 304 stainless steel.
- C. Inlet louvers shall be wave formed, fiberglass-reinforced polyester (FRP) or thermoformed of PVC and integrated with fill, spaced to minimize air resistance and prevent water splash-out.
- D. The tower structure, anchorage and all its components shall be designed by licensed professional engineers, employed by the manufacturer, per the International Building Code to withstand a wind load of 44 psf in any direction, as well as a .3g seismic load. The fan deck, hot-water basin covers and, where specified, maintenance platforms shall be designed for 60 psf live load or a 200 lb concentrated load. Guardrails, where specified, shall be capable of withstanding a 200 lb concentrated live load in any direction, and shall be designed in accordance with OSHA guidelines.
- E. All hardware including nuts, bolts, and washers shall be 304 stainless.

2.3 FAN MOTOR

- A. Select the motor so the brake horsepower required to deliver the design air quantity at the tower static pressure will not exceed the motor nameplate rating.
 - 1. Variable speed as scheduled.
 - 2. Field greaseable ball bearing type
 - 3. 1.15 service factor
 - 4. Premium Efficiency TEFC
 - 5. Inverter compatible for variable speed applications
 - 6. Cast iron material
 - 7. Will not exceed the motor nameplate rating
 - 8. Motor shall be out of the air stream
 - 9. Motor shall be out of the air stream and shall be connected to gear reducer by a dynamically balanced, stainless steel tube and flange driveshaft.

2.4 FAN

- A. Blades shall be slow speed, aerodynamically designed propeller type.

- B. Coat fan blades and hub with corrosion resistant material.
- C. Fabricate fan Venturi to provide eased inlet contour.
 - 1. Stainless steel wire ring type fan guard
- D. Belt Drive is not acceptable
- E. Gear drive only; belt drive is not acceptable
- F. Provide five-year parts and labor warranty for gear drives.
- G. Low noise fan.

2.5 FAN BEARING

- A. Grease lubricated and self-aligning

2.6 FILL

- A. Fill and eliminator shall be non-corrosive and non-ferrous.
 - 1. Polyvinyl chloride plastic material
 - 2. 10 to 15 mil minimum thickness after forming
 - 3. Rated to withstand 130°F maximum water temperature.
- B. The material shall be fire resistant and meet the provisions of ASTM E84 with a maximum flame spread rate of 25.
 - 1. Meet the provisions of ASTM E 84 with a maximum flame spread rate of 25.
- C. Drift loss shall be less than 0.005% of flow rate.

2.7 HOT WATER DISTRIBUTION SYSTEM

- A. Hot water distribution basin shall be the open basin gravity feed type or pressurized spray system
 - 1. Plastic diffuser metering orifices or spray nozzles.
- B. Provide 304 stainless steel removable hot water basin covers.
- C. The water distribution system shall be equipped with all required components to facilitate operation under variable flow conditions while maintaining a uniform air-side pressure drop through the fill to maximize cooling efficiency and minimize risk of ice and scale formation in the fill. System must accommodate flow rates down to at least 33% of design flow rates.
- D. Heavy duty flow regulators shall be provided at the hot water inlet connections. Valves shall be disc type, with cast iron bodies and stainless-steel stems.

2.8 BASIN ACCESSORIES

- A. Configured for mounting on field constructed concrete basin.
- B. Collection basin shall be provided with outlet openings designed for gravity flow discharge into concrete sump, including standpipes to maintain proper operation water levels inside basin. See piping diagram drawings for additional information.

- C. Overflow outlet fittings with grooved connection.
- D. Stainless steel anti-vortex plate.
- E. Quick fill connection.
- F. Equalizer piping connection.
- G. Bypass inlet fitting with grooved connection.
- H. Stand pipes shall be provided to maintain manufacturers recommended water level.
- I. Basin outlet size shall match pipe size of piping as shown on drawings. Reducers in the supply from tower basin are not acceptable.

2.9 COOLING TOWER MAKE UP WATER SYSTEM

- A. Precise water level control to within 1/8" of operating range
- B. Operating range of up to 6".
- C. Controller with a fill height, high level alarm, low level alarm, fault indicators and diagnostic self-test button.
- D. Watertight, dust tight, corrosion resistant NEMA 4x enclosure.
- E. With a 20" long, 3" diameter PVC pipe with 1/4" stainless steel probes.
- F. Stainless Steel mounting bracket.
- G. 120/1/60 electrical characteristics.
- H. Provide a 2" motorized ball valve Belimo model #B249 VS and a Belimo actuator model #AFRBUP Spring Return.
- I. Manufactured by Waterline Controls model #WLC5000-120VAC

2.10 VIBRATION SWITCH

- A. Electromechanical Design
- B. NEMA 4X weatherproof enclosure.
- C. Manual Reset
- D. Detect shock/vibration in three planes of motion.
- E. Sensitivity adjustment.
- F. Two SPDT snap switches.
- G. Time delay.
- H. Acceptable Manufacturers
 1. Frank W. Murphy
 2. Metrix Instrument Co.

2.11 OIL LEVEL SWITCH

- A. Explosion proof case.
- B. External site indication gauge.
- C. 304 stainless steel float.
- D. DPDT contacts.
- E. Acceptable Manufacturers
 - 1. Frank W. Murphy

2.12 SERVICE ACCESS (Per Cell)

- A. Provide an external service platform with ladder and supports to provide access inside tower.
 - 1. Provide a plenum walkway inside of tower.
 - 2. Provide elevated internal platform for access to mechanical equipment.
- B. Provide an external service platform with ladder and supports to provide access to service motor.
- C. Provide an external ladder and perimeter handrails for access to top of tower.
 - 1. Provide OSHA approved safety cage and ladder.
- D. All ladders shall have extensions to ground level.

2.13 ADDITIONAL ACCESSORIES

- A. Provide an external ladder and perimeter handrails for access to top of tower.
- B. Provide OSHA approved safety cage and ladder.
- C. Plenum walkway
- D. All ladders shall have extensions to ground level.

PART 3 - EXECUTION

3.1 MANUFACTURER INSTALLATION REQUIREMENTS

- A. Install all field accessories including but not limited to the following items not installed at factory:
 - 1. Upper fan cylinder
 - 2. Fan guard
 - 3. Distribution flume baffles
 - 4. Motor supports
 - 5. Motor and shaft
 - 6. Vibration & oil level switch
 - 7. Handrails
 - 8. Ladder and extension
 - 9. Safety Cage
 - 10. Service access platform
 - 11. Plenum walkway

12. Perimeter handrail, knee rail and toe board
 - B. Provide a factory-trained technician to supervise the installation of the cooling tower.
 - C. Built-in-place cooling tower erection on the structural foundation is by the manufacturer.
 - D. Tower support design is based upon the scheduled tower. Coordinate and provide revised support requirements if an alternate tower is furnished.
- 3.2 MANUFACTURER START-UP SERVICE AND ALIGNMENT
- A. Start-up the system in accordance with the manufacturer's installation, start-up and service instructions.
 - B. Technician shall be responsible for final checkout, adjustment and initial start-up of the tower.
 1. Correct operation of make-up water float valves.
 2. Correct setting of vibration cutout switches.
 3. Correct setting of oil level switches.
 4. Alignment of drive shaft.
 5. Fill basin with water and adjust operating level with pumps and towers energized.
 6. Clean hot and cold water basins.
 - C. Provide a written start-up report for inclusion in the Owner's Operating and Maintenance Manual.
- 3.3 COOLING TOWER MAKE-UP WATER SYSTEM
- A. Install all field accessories inside tower.
 - B. Coordinate field wiring to controller from sensor probe.
 - C. Coordinate sensor wire length minimum 50 ft. – 350 ft. maximum to control panel.
- 3.4 TRAINING
- A. The tower manufacturer shall provide two hours of onsite training for two owner's representatives to include the topics of use and maintenance of the cooling tower.

END OF SECTION

SECTION 23 73 13 - AIR HANDLING UNITS

PART 1 – GENERAL

1.1 WORK INCLUDED

- A. Furnish and install air handling units with casing, fans, coils, filters and special items.

1.2 RELATED WORK

- A. Division 23 Mechanical
 - 1. Air Balance
 - 2. Ductwork
 - 3. Controls
 - 4. Electrical Provisions of Mechanical Work
 - 5. Air Filtration
 - 6. Heating and Cooling Coils
 - 7. Other applicable sections

1.3 PERFORMANCE

- A. Unit capacities and characteristics as indicated.
 - 1. Units must be certified in accordance with ARI Standard 430-66.
 - 2. UL 1995 certification for safety including electric heat.
 - 3. ARI 430 listed and meet NFPA 90A requirements.

1.4 SHOP DRAWINGS

- A. Indicate assembly, unit dimensions, weight loading required clearances, construction details, field connection details, and electrical characteristics and connection requirements.
- B. Submit fan performance curve for each unit:
 - 1. Plot fan volume against static pressure, horsepower and efficiency.
 - 2. Show point of rating based on static requirements of the system.
 - 3. Chart of specific sound power level at each octave band center frequency.
 - 4. For variable volume units, plot fan volume over entire range.
- C. Submit for review a unit internal static pressure loss calculation.
 - 1. Provide an itemized list of static pressure loss at the scheduled CFM for each unit component including and not limited to:
 - a. Coils
 - b. Dirty filters
 - c. Fan and unit system effect
 - d. Cabinet and cabinet inlet and outlet
 - e. Unit mounted dampers
 - 2. If a unit mounted outside air pretreatment section without supply fan, "piggyback" is specified:
 - a. Provide an itemized static pressure loss as indicated above.
 - b. Determine losses for unit configuration, i.e. parallel or series.
 - c. Include losses in the primary unit internal static pressure required by configuration.
 - 3. The air handling unit schedule indicates static pressure external to the unit and does not include any losses associated with the air handling equipment.

1.5 ENVIRONMENTAL REQUIREMENTS

- A. Do not operate units until ductwork is clean, filters are in place, bearings lubricated, condensate properly tapped, piping connections verified and leak tested, belts aligned and tensioned, all shipping braces have been removed, and fan has been tested under observation.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Inspect for transportation damage and store in a clean, dry location. Protect from weather and construction traffic.
- B. Manufacturer shall provide quick shipment options to minimize product lead times.

1.7 WARRANTY

- A. The Air Handling Unit manufacturer shall provide a full machine parts and labor warranty for a period of one (1) year from substantial completion.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Carrier
- B. Daikin
- C. JCI
- D. Temtrol
- E. Thermal
- F. Trane

2.2 MISCELLANEOUS REQUIREMENTS

- A. Provide factory assembled units. Large units may be shipped in sections, at contractor's option, to enable entrance to building, or for oversize shipping reasons only.
- B. Furnish units with sealing and fastening hardware supplied by the manufacturer. Include written instructions needed to complete field assembly of the components.
- C. Provide units designed and constructed so that coils, panels, fan housing and fans can be removed without affecting the structural integrity of the unit.
- D. Unit casing panels shall be double wall construction with solid galvanized exterior and solid galvanized interior. Panels shall have a minimum thermal resistance of R-13. The casing shall not exceed 0.0042 inch deflection per inch of panel span at 1.5 times the design static pressure up to a maximum of +8 inches in all positive pressure sections and -8 inches in all negative pressure sections.
- E. Provide full perimeter base rail channel under units constructed of heavy gauge galvanized steel (minimum 10 gauge) and intermediate cross members to assure unit integrity. Provide minimum size base rail to ensure proper trapping and slope of condensate drain (minimum 6 inch from bottom of drain opening).

- F. Fan assembly shall be provided with 1" deflection internally mounted spring vibration isolation under the fan and motor base on units with coils less than 8 sq. ft. and 2" deflection internally mounted spring vibration isolation under the fan and motor base with coils greater than 8 sq. Ft. Units with coils over 35 sq. ft. shall have spring thrust restraints securing the fan housing to the discharge opening panel on units. Fan motor shall be internally mounted. Provide internal flex connection of fan discharge. Maximum acceptable RPM of fan shall not exceed 1000.
- G. Provide factory installed removable hinged access doors in the following locations:
 - 1. Entering and leaving side of all coils to allow for cleaning of coils on both sides of unit.
 - 2. Each side of filter compartment to allow changing of filters from either side.
 - 3. Each side of motor compartment to allow motor and isolation access.
 - 4. Each side of condensate drain pan to allow for cleaning and inspection.
 - 5. Swing the doors against the casing static pressure.
- H. Provide all coil modules, including heating coil modules, with stainless steel drain pans to facilitate cleaning and maintenance of the coils. Drain pan to extend 10" minimum downstream of cooling coil.
- I. Provide coils with stainless steel casings, end plates, tube supports and top & bottom plates.
- J. Units shall meet ASHRAE III Class 6 Low Leakage Standard. Casing shall have less than a 1% leakage rate at plus or minus 8 inches W.G.

2.3 DRAW THROUGH AIR HANDLING UNITS

- A. Provided with:
 - 1. Non-Overloading direct drive plenum fans. Provide minimum number of fans as indicated on drawings.
 - 2. Insulated sheet metal cabinet with removable panels for access to the interior.
 - 3. Hinged double wall doors with two-step safety handles.
- B. Drive assembly:
 - 1. Sized for 50% overload.
- C. Motors and Control:
 - 1. Totally enclosed, fan cooled, Variable speed, 1750 rpm.
 - 2. Maximum operating point of 70 Hz.
 - 3. Minimum 90% nominal efficiency at loads of 70%-100%.
 - 4. Premium efficiency inverter duty
 - 5. NEMA B design, with Class B insulation, capable to operate continuously at 104 deg F without tripping overloads.
 - 6. +/- 10% voltage utilization range to protect against voltage variation.
 - 5. Cast iron frame and end plate
 - 6. Forged steel lifting eye
 - 7. Oversized conduit box with ground lug
 - 8. Provide with factory installed shaft grounding rings by Aegis
 - 9. Motor selected so that the brake horsepower required to deliver the design air quantity at the system static pressure will not exceed the motor nameplate rating.
- D. Supply Fans:
 - 1. Single width, single inlet, backward curved welded aluminum plenum fan.

2. Statically and dynamically balanced to a BV-3 per AMCA 204 test standard.
 3. Tested after being installed in the fan sections.
 4. Selected for the design air quantities and pressure of the system.
 5. Mounted on a common shaft if multiple wheels.
 6. The fan shall be rated in accordance with AMCA 210 for performance and AMCA 260 for sound.
 7. Minimum of Class II fan.
- E. Fans selected with isolation shall be internally isolated with spring isolators. A flexible connection shall be installed between fan and unit casing to ensure complete isolation. Flexible connection shall comply with NFPA 90A and UL 181 requirements. If fans and motors are not internally isolated, then the entire unit shall be externally isolated from the building, including supply and return duct work, piping, and electrical connections. External isolation shall be furnished by the installing contractor to avoid transmission of noise and vibration through the ductwork and building structure.
- F. Each direct drive fan in a multiple-fan array shall be provided with integral back flow prevention: a backdraft damper that prohibits recirculation of air in the event a fan or multiple fans become disabled. Dampers are tested and rated based on AMCA Standard 500. Dampers to be heavy duty type capable of a maximum back pressure that exceeds the design total static pressure with minimal leakage. The dampers should have a minimal total effect on airflow performance; both pressure drop when open and system effect on the fan. The damper blades and frame shall be extruded aluminum with blade edge seals locked into the blade edge. Adhesive type seals are unacceptable. AHU manufacturer responsible for providing proper spacing upstream of dampers to ensure full, uniform airflow through upstream components. For units where the damper(s) are supplied at the jobsite, the installing contractor shall contract a certified TAB contractor to verify uniform airflow thru upstream components.
- G. Select fan to operate at or near its maximum efficiency point when handling the required air quantity and static pressure.
- H. Stainless steel condensate pan with positive slope in all directions to outlet. Line the condensate drain pan with minimum 2" waterproof insulation.
- I. Insulation, vapor barriers, facings and adhesives shall have:
 1. Flame spread not higher than 25.
 2. Smoke developed rating not higher than 50.
- K. Filter section:
 1. Constructed with substantial hinges.
 2. Neoprene gasketing.
 3. Permanent quick release latching devices.
 4. Arranged to accommodate 2" thick filters as specified.
 5. Filter rack shall be factory manufactured to accommodate the filter sizes listed below. Filter racks shall not be altered in the field.
 6. Low velocity angled filter section unless otherwise specified.
 7. 16x20x2, 16x25x2, 20x20x2, 20x25x2 only.
- L. Cooling coils as specified. Extend drain and vent piping through cabinets. Provide grommets at all pipe penetrations through cabinets.
- M. Heating coils as specified. Extend drain and vent piping through cabinets. Provide grommets at all pipe penetrations through cabinets.

- N. Provide each fan section with an additional 2" thick perforated metal inner liner which utilizes fiberglass insulation. Liner shall be installed on all walls and top surface.
- O. Factory dynamic fan balancing shall be conducted from 16Hz to 60Hz to identify and eliminate critical speeds to ensure stable operation through the entire operating range of the fan and drive assembly. Field fan balancing is not acceptable. Forward factory balancing test report to Engineer upon request.

2.4 BLOW THROUGH VARIABLE AIR VOLUME AIR HANDLING UNIT – DOUBLE DUCT

- A. Provided with:
 - 1. Non-Overloading direct drive plenum fans. Provide minimum number of fans as indicated on drawings.
 - 2. Insulated sheet metal cabinet with removable panels for access to the interior.
 - 3. Hinged double wall doors with two-step safety handles.
- B. Drive assembly:
 - 1. Sized for 50% overload.
- C. Motors and Control:
 - 1. Totally enclosed, fan cooled, Variable speed, 1750 rpm.
 - 2. Maximum operating point of 70 Hz.
 - 3. Minimum 90% nominal efficiency at loads of 70%-100%.
 - 4. Premium efficiency inverter duty
 - 5. NEMA B design, with Class B insulation, capable to operate continuously at 104 deg F without tripping overloads.
 - 6. +/- 10% voltage utilization range to protect against voltage variation.
 - 5. Cast iron frame and end plate
 - 6. Forged steel lifting eye
 - 7. Oversized conduit box with ground lug
 - 8. Provide with factory installed shaft grounding rings by Aegis
 - 9. Motor selected so that the brake horsepower required to deliver the design air quantity at the system static pressure will not exceed the motor nameplate rating.
- D. Supply Fans:
 - 1. Single width, single inlet, backward curved welded aluminum plenum fan.
 - 2. Statically and dynamically balanced to a BV-3 per AMCA 204 test standard.
 - 3. Tested after being installed in the fan sections.
 - 4. Selected for the design air quantities and pressure of the system.
 - 5. Mounted on a common shaft if multiple wheels.
 - 6. The fan shall be rated in accordance with AMCA 210 for performance and AMCA 260 for sound.
 - 7. Minimum of Class II fan.
- E. Fans selected with isolation shall be internally isolated with spring isolators. A flexible connection shall be installed between fan and unit casing to ensure complete isolation. Flexible connection shall comply with NFPA 90A and UL 181 requirements. If fans and motors are not internally isolated, then the entire unit shall be externally isolated from the building, including supply and return duct work, piping, and electrical connections. External isolation shall be furnished by the installing contractor to avoid transmission of noise and vibration through the ductwork and building structure.
- F. Each direct drive fan in a multiple-fan array shall be provided with integral back flow prevention: a backdraft damper that prohibits recirculation of air in the event a fan or multiple fans become disabled. Dampers are tested and rated based on AMCA Standard

500. Dampers to be heavy duty type capable of a maximum back pressure that exceeds the design total static pressure with minimal leakage. The dampers should have a minimal total effect on airflow performance; both pressure drop when open and system effect on the fan. The damper blades and frame shall be extruded aluminum with blade edge seals locked into the blade edge. Adhesive type seals are unacceptable. AHU manufacturer responsible for providing proper spacing upstream of dampers to ensure full, uniform airflow through upstream components. For units where the damper(s) are supplied at the jobsite, the installing contractor shall contract a certified TAB contractor to verify uniform airflow thru upstream components.

- G. Select fan to operate at or near its maximum efficiency point when handling the required air quantity and static pressure.
- H. Stainless steel condensate pan with positive slope in all directions to outlet. Insulate the condensate drain pan with a minimum of 1-1/2" waterproof insulation.
- I. Insulation, vapor barriers, facings and adhesives shall have:
 - 1. Flame spread not higher than 25.
 - 2. Smoke developed rating not higher than 50.
- J. Filter section:
 - 1. Constructed with substantial hinges.
 - 2. Neoprene gasketing.
 - 3. Permanent quick release latching devices.
 - 4. Arranged to accommodate 2" thick filters as specified.
 - 5. Filter rack shall be factory manufactured to accommodate the filter sizes listed below. Filter racks shall not be altered in the field.
 - 6. Low velocity angled filter section unless otherwise specified.
 - 7. 16x20x2, 16x25x2, 20x20x2, 20x25x2 only.
- K. Cooling coils as specified. Extend drain and vent piping through cabinets. Provide grommets at all pipe penetrations through cabinets.
- L. Heating coils as specified. Extend drain and vent piping through cabinets. Provide grommets at all pipe penetrations through cabinets.
- M. Provide a factory installed equalizing grid in the hot deck where heating coils are not installed.
- N. Factory dynamic fan balancing shall be conducted from 16Hz to 60Hz to identify and eliminate critical speeds to ensure stable operation through the entire operating range of the fan and drive assembly. Field fan balancing is not acceptable. Forward factory balancing test report to Engineer upon request.
- O. Design the entrance to the hot and cold decks and baffle to preclude wiping action of the air stream.
- P. Provide units with factory fabricated mixing box section that include an additional 2" thick metal perforated inner liner which utilizes fiberglass insulation. Liner shall be installed on all walls and top surface.
- Q. Provide each fan section with an additional 2" thick perforated metal inner liner which utilizes fiberglass insulation. Liner shall be installed on all walls and top surface.
- R. Factory dynamic fan balancing shall be conducted from 16Hz to 60Hz to identify and

eliminate critical speeds to ensure stable operation through the entire operating range of the fan and drive assembly. Field fan balancing is not acceptable. Forward factory balancing test report to Engineer upon request.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install air handling units according to manufacturer's instructions.
- B. Provide additional drive packages as required by the Testing and Balancing firm.
- C. Air leaks detectable by sound or touch are to be corrected.
- D. Air handling units are to be properly supported to prevent flexing, bending or distorting base rails.
- E. All coils and drain pans are to be cleaned prior to substantial completion if units are used during construction.
- F. Clean all air handling units and return to original manufacturer's condition prior to substantial completion. Vacuum clean all debris from inside air handling equipment.
- G. Install piping to unit with full size 6 inch long dirt leg with 1/2" valve at bottom for cleaning.
- H. Provide for positive gravity drainage of coil condensate. Pipe full size of unit connection.
- I. Adjust fan drives as required to obtain scheduled capacities as directed by the Test and Balance Firm to include sheave and belt replacement.
- J. Align belts to eliminate wear and vibration of belts.
- K. Verify correct drainage of condensate from condensate pan.
- L. Verify correct rotation of fan and wiring of motor.
- M. Lubricate all greaseable ball bearings with manufacturer's suggested lubricant.
- N. Replace filters as required if units are used during construction.
- O. Provide piping installation so that after piping is completed and insulated there is full access to service unit and remove fan housing. Piping to coils shall not block fan section access or cause damage to piping insulation during access.
- P. AHU motors must be wired with Kernay connections inside motor terminal boxes. No wire nuts. Kernay connections must be wrapped with rubber and electrical tape for insulation.

3.2 IDENTIFICATION

- A. Furnish each unit with a durable, deep etched, .025" thick, factory installed aluminum identification plate, permanently mounted with the following information:
 - 1. Unit identification as indicated on Contract Drawings.
 - 2. Serial Number.
 - 3. Model Number.
 - 4. Capacity (CFM) and static pressure.
 - 5. Motor HP.

6. Unit power supply: Volts / PH / Amps.
7. Supply Fan Type.
8. Coil GPM and pressure drop.
9. Sales Order #.
10. Date unit manufactured.

END OF SECTION

SECTION 23 82 16 - HEATING AND COOLING COILS

PART 1 – GENERAL

1.1 WORK INCLUDED

- A. Furnish and install heating and cooling coils.

1.2 SUBMITTALS

1.3

- A. Submit manufacturer's product data sheets and unit capacity information as specified.
- B. Submit manufacturer's Installation, Start-Up and Service Instructions.
- C. Submit internal wiring diagram.
 - 1. Electrical interlocks. *

1.3 RELATED WORK

- A. Division 23 Mechanical.
 - 1. Air Handling Units.
 - 2. Fan Coil Units.
 - 3. Weatherproof Roof Mounted Air Handling Units.
 - 4. Ductwork.
 - 5. Terminal Boxes.

PART 2 – PRODUCTS

2.1 HOT WATER COILS

- A. Hot water coils:
 - 1. Constructed of copper tubes and aluminum fins.
 - 2. Designed and circuited for hot water.
 - a. Maximum temperature 200°F.
- B. Where coils are installed in fan powered VAV boxes, unit heaters and other locations the maximum approved fin spacing is 8 fins per inch.
- C. Non-trapping circuit design:
 - 1. Working pressure 200 psi
 - 2. Tappings for drain and air vent
- D. Provide a Peterson Pete's Plug with retainer strap on the inlet and outlet of each coil.
 - 1. Positioned to permit accurate pressure readings.
- E. Coils shall be constructed in casings as required for installation.
- F. Heating coils installed within ductwork or on the leaving side of a terminal unit shall be installed with a transition ductwork section to match the full face area of the heating coil. Provide an access door on both the entering and leaving sides of the duct mounted coil.

2.2 CHILLED WATER COILS

- A. Chilled water coils:
 - 1. Constructed of copper tubes and aluminum fins
 - 2. Designed and circuited for chilled water
 - 3. Minimum of six rows

- B. Non-trapping circuit design:
 - 1. Working pressure 200 psi.
 - 2. Tappings for drain and air vent.
- C. Provide a Peterson Pete's Plug with retainer strap on the inlet and outlet of each coil. Position to permit accurate pressure readings.
- D. Coils shall be constructed in casings as required for installation.
- E. Where coils are stacked, provide intermediate drain pans with drop tubes to drain condensate to the main drain pan without flooding the lower coil.

2.3 DIRECT EXPANSION COOLING COILS

- A. DX cooling coils:
 - 1. Constructed of copper tubes and aluminum fins.
 - 2. Designed and circuited for use with direct expansion refrigeration.
- B. Cooling coil face velocity:
 - 1. Not of magnitude to cause moisture to be carried off the coil.
 - 2. Maximum velocity as scheduled.
- C. Circuit cooling coil with interlaced tubes so the entire face is active under all modes of unloading. Refer to the schedule on the drawings.
- D. Coils shall be constructed in casings as required for installation.
- E. Where coils are stacked, provide intermediate drain pans with drop tubes to drain condensate to the main drain pan without flooding the lower coil.

2.4 ELECTRIC HEATERS

- A. Capacity shall be as scheduled on the drawings. Heater shall have 80% nickel, 20% chromium, open resistance coils insulated by floating ceramic bushings, and be supported in an aluminum steel frame.
- B. Ceramic bushings shall be recessed into embossed openings and staked into supporting brackets spaced 3-1/2" maximum center to center.
- C. Coil shall be machine-crimped into threaded terminals and insulated with phenolic bushings. All terminal hardware shall be stainless steel.
- D. Heater shall be listed by the Underwriters Laboratories for zero clearance to combustible surfaces and for use with central air conditioners.
- E. For primary protection, furnish a disk-type automatic reset thermal cutout for pilot duty only.
- F. For secondary protection, load-carrying manual reset thermal cutouts shall be wired in series with each heater circuit. Cutouts shall be rated at 480 volts minimum.
- G. Voltage, phase and number of heating stages shall be furnished in accordance with duct heater schedule. Three-phase heaters shall have single-phase circuits for operation from a 3-phase, 4-wire power source. Circuits shall be rated at 48 amperes maximum. Furnish one set of line terminals to feed all circuits. Heater shall be tested dielectrically at 2000 volts before shipment. Field-installed conductors feeding the heater shall be sized for

125% of the connected load.

- H. Built-in components shall be factory wired to terminal blocks for field connection. All internal wiring shall be insulated for 105°C. Built-in magnetic contactors shall disconnect all ungrounded conductors to each circuit. Furnish heaters with an air flow switch that will not allow heaters to energize without proof of air flow. Built-in transformer shall be dry industrial type, sized to carry full contactor holding coil load. Primary windings shall be fused at the factory. Built-in fuses shall be factory wired to each circuit to protect all underground conductors. Type NON or NOS fuses to be factory installed in phenolic fuse blocks. Built-in disconnect switch to be snap action, industrial type. Provide a door interlock mechanism to prevent hinged terminal box cover from being opened when the switch is on. Switch shall be unfused.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install the duct heaters in accordance with the manufacturer's Installation, Start-Up and Service Instructions.

END OF SECTION

SECTION 23 82 18 - DUCTLESS MINI SPLIT DX UNITS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish and install mini split system. Complete with a slim silhouette, compact, high wall fan coil section with a wired wall mounted thermostat and a slim silhouette horizontal discharge outdoor condensing unit. Unit shall be provided with inverter driven compressor, pre-charged with R410A or R32 refrigerant. air-cooled condensing units complete with casing, compressor, condenser coil, condenser fan and controls required for a split air conditioning system.

1.2 RELATED WORK

- A. Refrigerant Piping.
- B. Electrical Provisions of Mechanical Work.

1.3 PERFORMANCE

- A. Provide performance as scheduled on drawings, and head pressure control to enable unit to operate in temperatures as low as 20 degrees F. ambient.

1.4 QUALITY ASSURANCE

- A. The units shall be tested by a Nationally Recognized Testing Laboratory (NRTL) and bear the ETL label.
- B. All wiring shall be in accordance with the National Electrical Code (N.E.C.).
- C. The units shall be rated in accordance with Air-conditioning, Heating, and Refrigeration Institute's (AHRI) Standard 210 and bear the AHRI Certification label.
- D. The units shall be manufactured in a facility registered to ISO 9001 Quality assurance Standards and ISO 14001 which are set of standards applying to sustainability and environmental protection set by the International Standard Organization (ISO).
- E. A pressure charge of R410A or R32 refrigerant sufficient for up to twenty-five (25) feet of refrigerant tubing shall be provided in the outdoor condensing unit.
- F. A dry air holding charge shall be provided in the indoor section.

1.5 WARRANTY

- A. Unit shall have a manufacturer's parts and defects warranty for a period five (5) years from the date of the original installation. The compressor shall have a warranty of seven (7) years from date of installation. Warranties shall start at the date of substantial completion.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Daikin
- B. Trane - Mitsubishi
- C. LG

2.2 INDOOR UNIT GENERAL

- A. The indoor shall be factory assembled, wired and run tested. Contained within the unit cabinet shall be all factory wiring, internal piping, electronic control circuit board and fan with fan motor.
- B. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, and auto restart after power interruption function, an emergency operation function and a test run switch.
- C. Indoor unit and refrigerant pipes shall be charged with dry air before shipment from the factory. All refrigerant piping must be insulated.

2.3 CABINET

- A. The casing shall have a smooth front, top return, in a white finish.
- B. Multi directional drain and refrigerant piping offering four (4) directions for refrigerant piping and two (2) directions for draining shall be standard.
- C. There shall be a separate installation plate which secures the unit firmly to the wall. Secure mounting of plate and all mounting hardware shall be furnished by and be the responsibility of the installer.

2.4 FAN

- A. The indoor unit fan shall be an assembly with a line-flow fan direct driven by a single motor mounted in rubber motor mount.
- B. The fan shall be statically and dynamically balanced and run on a motor with permanently lubricated bearings.
- C. Manual adjustable vertical guide vanes shall be provided with the ability to change the airflow from side to side (left to right).
- D. An integral, motorized, horizontal air sweep flow louver shall provide an automatic change in airflow by directing the air up and down to provide for uniform air distribution.
- E. The indoor unit fan motor shall operate in four (4) selectable speeds, Powerful, High, Medium, and Low.

2.5 FILTER

- A. Return air shall be filtered by means of easily removed, washable, Catechin air filter and an anti-allergy enzyme filter – blue bellows type.

2.6 COIL

- A. The indoor unit (evaporator) coil shall be of nonferrous construction with smooth, pre-coated aluminum fins on copper tubing.
- B. Tubing shall have inner grooves for high efficiency heat exchange.
- C. All tube joints shall be brazed with PhosCopper or silver alloy.
- D. The coil shall be pressure tested at the factory.
- E. A sloped condensate pan and drain shall be provided under the coil. Drain connections shall be provided at each end of the drain pan.

2.7 ELECTRICAL

- A. Power for the indoor unit shall be supplied from the outdoor unit.
- B. Power supply shall be as indicated on the drawings.
- C. The unit shall be equipped with a micro-processor control system directing indoor and outdoor unit coordinated operation.
- D. The indoor unit shall not have any supplemental electrical heat elements.

2.8 CONTROL

- A. This system shall have a wired wall mounted thermostat/controller to perform input functions necessary to operate the system. The controller shall consist of a Power On / Off switch, Mode Selector, Temperature Setting, Timer Control, Fan Speed Select and Auto Vane Selector.
- B. Temperature changes shall be by 1°F increments with a range of 65°F to 87°F.
- C. There shall be a 24 hour On / Off timer.
- D. The microprocessor located in the indoor unit shall have the capability of sensing return air temperature and indoor coil temperature, receiving and processing commands from the space controller, providing emergency operation and controlling the outdoor unit.
- E. The control voltage between the indoor unit and the outdoor unit shall be 115 volts, AC.
- F. The system shall be capable of automatic restart when power is restored after power interruption.
- G. The control system shall control the operation of the air sweep louvers, as well as provide on / off and system / mode function switching.

2.9 OUTDOOR UNIT GENERAL

- A. The outdoor unit is designed specifically for use with the indoor units. The outdoor unit shall be completely factory assembled, internally piped and wired. Each unit shall be run tested at the factory.

- B. When refrigerant lines are exposed on exterior of building provide "LINE-HIDE" line set cover system.
 - 1. Material, Weather resistant, UV stabilized, ASA/PVC/ABS/Poly/PE
 - 2. Assembly Screws, stainless steel.

2.10 UNIT CABINET

- A. The casing shall be fabricated from zinc coated steel, bonderized with an electrostatically applied, thermally bonded, acrylic or polyester powder coating for corrosion protection.
- B. Case and mounting feet shall be as follows:
 - 1. The base shall be of Aluminum-Zinc-Magnesium alloy coated steel, with welded mounting feet.
- C. Cabinet mounting and construction shall be sufficient to withstand 155 MPH wind speed conditions for use in Hurricane condition areas. Mounting, base support, and other installation to meet Hurricane Code Conditions shall be by others.

2.11 FAN

- A. The unit shall be furnished with a directive drive propeller type fan, statically and dynamically balanced for smooth and quiet operation.
- B. The fan motor shall have inherent protection, be equipped with permanently lubricated bearings. The fan motor shall be mounted and isolated for quiet operation.
- C. The fan shall be provided with a raised guard to prevent contact with moving parts.
- D. The outdoor unit shall have horizontal discharge airflow.

2.12 COMPRESSOR

- A. The compressor shall be a high performance, inverter driven rotary type.
- B. Compressor shall be mounted using rubber isolating bushings to avoid the transmission of vibration.
- C. Compressor shall be protected by an automatic over current relay and a thermal overload switch.

2.13 OPERATION

- A. The outdoor unit shall have an accumulator.
- B. The outdoor unit must have the ability to operate with a maximum height difference of 35 feet between indoor and outdoor units.
- C. The unit shall have a maximum refrigerant tubing length of 65 feet between indoor and outdoor units without the need for line size changes, traps or additional oil. All refrigerant lines must be insulated.
- D. The unit shall be pre-charged for a maximum of 25 feet of refrigerant tubing.

2.14 ELECTRICAL

- A. Power supply shall be as indicated on the drawings.
- B. The outdoor unit shall be controlled by the microprocessor located in the indoor unit. The control voltage between the indoor unit and the outdoor unit shall be 115 volts, AC.

2.15 WALL AND ROOF BRACKET

- A. As indicated on the drawings, provide each unit 3 tons and below with a stainless steel mini-split condenser bracket.
- B. Unit shall be constructed for a maximum weight of 300 lbs.
- C. Unit shall be manufactured by Rectorseal model #WBB-300SS or Diveritech model #QSWB4000SS or approved equal.

2.16 CONDENSATE PUMPS

- A. A condensate pump shall only be provided as a means of condensate disposal when a gravity drain is not available.
- B. Provide a Little Giant Model #554642 VCMA-20ULS-C-PRO-20.
- C. Unit shall be provided with anti-sweat sleeve, tank bracket and overflow detection switch.
- D. Condensate pump shall be wall mounted. Mount pump under wall cassette.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Where indicated on drawings, mount condensing units on 4" foundation pads or install unit mounted utilizing wall bracket for both wall mounting and roof installation. Install refrigerant filter dryer and sight indicating glass.
- B. Install units on vibration isolation pads.
- C. Ensure unit provided will meet the refrigerant and line lengths required by the installation as indicated on the drawings.
- D. Provide convenience water and electrical within 50 feet of new condensing unit.

3.2 CONTROL WIRING

- A. Furnish and install control wiring as required. Install control wiring in conduit.

3.3 DELIVERY, STORAGE AND HANDLING

- A. Unit shall be stored and handled according to the manufacturer's recommendations.
- B. The wired controller shall be shipped inside the carton with the indoor unit and able to withstand 105°F storage temperatures and 95% relative humidity without adverse effect.

3.4 START-UP

- A. Follow the manufacturer's start-up procedures.
- B. Provide flexible elastomeric rubber closed cell insulation to prevent condensation from occurring on suction piping. After completion of successful start-up, installing contractor shall seal all openings in insulation and apply a protective aluminum sheetmetal jacket over insulation exposed on exterior of building.

END OF SECTION

SECTION 23 82 19 - FAN COIL UNITS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Floor mounted decorative cabinet fan/coil units, horizontal fan/coil units for concealed installation and horizontal exposed ceiling mounted fan/coil units with decorative cabinet.

1.2 RELATED WORK

- A. Division 23 Mechanical
 - 1. Air Balance
 - 2. Controls
 - 3. Electrical Provisions of Mechanical Work
 - 4. Ductwork
 - 5. Air filtration
- B. Section 23 05 48 HVAC Vibration Isolation
- C. Section 23 05 50 Noise Control for Mechanical Systems

1.3 REFERENCES

- A. ANSI/AHRI 410 - force circulation air cooling and air heating coils
- B. National Electrical Code

1.4 SUBMITTALS

- A. Submit manufacturer's dimensioned product data sheets.
 - 1. Show location of filter access doors.
- B. Submit fan performance curve for each unit:
 - 1. Plot fan volume against static pressure, horsepower and efficiency.
 - 2. Show point of rating based on static requirements of the system.
- C. Submit the fan performance plot at each motor speed position with consideration for the reduced internal static.
- D. Submit a chart of specific sound power level at each octave band center frequency. Sound power levels to occupied space shall not exceed the NC levels specified in 23 05 47 as calculated using ARI 885-98 Appendix E attenuation factors for mineral tile ceiling.
- E. Submit manufacturer's certified heating and cooling coil capacity data.
- F. Submit filter manufacturer's product data sheets and capacity information.
- G. Submit manufacturer's data on housing insulation material.

1.5 CAPACITY

- A. Refer to equipment schedule.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Carrier
- B. Daikin
- C. Trane

2.2 NOISE AND VIBRATION

- A. Refer to Section 23 05 48 Vibration Isolation and 23 05 50 Noise Control for Mechanical Systems for additional requires that apply.

2.3 COMPONENTS

- A. Fan section
- B. V-belt drive assembly, or,
- C. Multi-speed direct connected motor
- D. Filter section, refer to section 23 41 00 for acceptable filter sizes.
- E. Coil section
- F. Insulated sheet metal cabinet with removable panels for access to the interior
- G. Motor and drive inside the cabinet

2.4 FAN SECTION

- A. Locate the motor and drive assembly inside the cabinet.
- B. Belt drive units shall have each v-belt drive for 50% overload.
 - 1. Adjustable pitch motor pulley
 - 2. Provide built-in motor protection
 - 3. Belt adjustment means
 - 4. Type "B" belts only.
- C. Direct drive units shall multi-speed direct connected fan motor with built-in motor protection.
 - 1. Three-speed windings
 - 2. Factory wired to a junction box with provisions for motor speed change, mounted on the box
 - 3. Resiliently mounted
- D. Select the fan motor so that the brake horsepower required to deliver the design air quantity at the system static pressure will not exceed the motor nameplate amperage rating.
- E. Supply Fans:
 - 1. Double width, double inlet, forward curve blade
 - 2. Statically and dynamically balanced
 - 3. Tested after being installed in the fan section
 - 4. Selected for the design air quantities and static pressure of the system
 - 5. Mounted on a common shaft if multiple wheels

- F. Select fan to operate at or near its maximum efficiency point when handling the required air quantity and static pressure.
- G. Fan Bearings:
 - 1. Permanently lubricated
 - 2. Self-aligning

2.5 DECORATIVE HOUSING AND PLENUM

- A. Where units are exposed to view in occupied spaces and where scheduled, construct cabinets of cold rolled steel, bonderized and coated with baked enamel finish.
- B. Access panels shall have position locking fasteners for easy removal.
 - 1. Plated screws with captive nuts
 - 2. Hinged if too large for one man operation

2.6 UNIT HOUSING

- A. Construct the unit of galvanized steel sheets, and formed members.
 - 1. Provide structure to brace the assembly for the pressure of the system.
- B. Bolt housing components together with neoprene gasketed airtight joints.
- C. Internally insulate the entire unit with neoprene coated, 1-1/2 lb. density glass fiber insulation, applied to internal surfaces with adhesive and weld pins. Coat exposed edges of insulation with adhesive.
- D. Insulation, vapor barriers, facings and adhesives:
 - 1. Flame spread not higher than 25
 - 2. Smoke developed rating not higher than 50
- E. Condensation on the exterior of the unit is not approved.
- F. Provide a duct flange on four sides of the return air inlet and supply air outlet of the unit.
 - 1. Sized to permit connection of the flexible connection to the ductwork
 - 2. Extend beyond the primary drain pan
 - 3. Minimum dimension 2"
- G. Provide insulated, removable panels for access to the interior.
 - 1. Plated captive screws and nuts
 - 2. Neoprene gaskets

2.7 CONDENSATE DRAIN PANS

- A. IAQ style drain pans shall be provided under all coils.
 - 1. Pitch to drain connection
 - 2. Fabricated from 16 gauge 304 stainless steel
 - 3. Triple pitched for complete drainage with no standing water
 - 4. Insulated to prevent condensation
 - 5. Welded corners
 - 6. Stainless drain connection

2.8 COILS

- A. Reference Schedule and Specification Section 23 82 16.

2.9 FILTER SECTION

- A. Locate behind access doors.
 - 1. Construct with substantial hinges
 - 2. Neoprene gaskets
 - 3. Permanent quick-release latching devices
- B. Arranged to accommodate the 1" thick filters as specified.
 - 1. Single section filter - 16x20x2, 16x25x2, 20x20x2, 20x25x2 only.
- C. Provide full length tracks to support the filter.

PART 3 - EXECUTION

3.1 SPARE PARTS

- A. Provide the following spare parts and material to the Owner for use after the warranty period.
 - 1. One spare fan motor for each size of fan motor on the project
 - 2. One spare set of filters or filter media for each fan coil unit on the project

3.2 ELECTRICAL REQUIREMENTS

- A. Bring electrical connections to a common junction box.

3.3 STORAGE

- A. Storage and shipping in accordance with manufacturer's recommendations.

3.4 INSTALLATION

- A. Install unit so motor connections and filters are accessible.

END OF SECTION

**SECTION 26 01 05 - ELECTRICAL OPERATING AND
MAINTENANCE MANUALS**

PART 1 – GENERAL

1.1 WORK INCLUDED

- A. Compile electrical product data and related information appropriate for Owner's operation and maintenance of products furnished under Contract. Prepare electrical operating and maintenance data as specified in this Section and as referenced in other sections of specifications.
- B. Instruct Owner's personnel in operation and maintenance of equipment and systems.
- C. Submit 3 copies of complete manual in final form.

1.2 ELECTRICAL OPERATING AND MAINTENANCE MANUAL SUBMITTAL SCHEDULE

- A. Thirty (30) days after receipt of reviewed submittals bearing the Architect / Engineer's stamp of acceptance (including re-submittals), submit for review 1 copy of the first draft of the Electrical Operating and Maintenance Manual. This copy shall contain as a minimum:
 - 1. Table of Contents for each element
 - 2. Contractor information
 - 3. All shop drawings, coordination drawings and product data, bearing the Architect / Engineer's stamp of acceptance.
 - 4. All parts and maintenance manuals for items of equipment
 - 5. Warranties (without starting dates)
 - 6. Certifications that have been completed; submit forms and outlines of certifications that have not been completed
 - 7. Operating and maintenance procedures.
 - 8. Form of Owner's Training Program Syllabus (including times and dates)
 - 9. Control operations / equipment wiring diagrams
 - 10. Coordination Drawings
 - 11. Schedule of Lamps, Light Engines
 - 12. Schedule of Ballasts and Drivers
 - 13. Schedule of Fuses
 - 14. Other required operating and maintenance information that are complete.
- B. Copy will be returned to the Contractor within 15 days with comments for corrections.
- C. Submit the completed manuals in final electronic form to the Architect / Engineer.
 - 1. Prior to substantial completion for Owner's use after the Owner accepts facility maintenance.
 - 2. Include all specified data, test reports, drawings, dated warranties, certificates, along with other materials and information.
- D. The Architect / Engineer shall review the manuals for completeness within 15 days.
- E. The Contractor shall be notified of any missing or omitted materials. The Manuals shall be reworked by the Contractor, as required, in the office of the Architect / Engineer. The manuals will not be retransmitted.
- F. Complete electronic manuals shall be delivered to the Owner prior to substantial completion.

PART 2 – PRODUCTS

2.1 BINDERS

- A. Commercial quality black, 3-ring binders with clear, durable, cleanable plastic covers.
- B. Minimum ring size: 1"; Maximum ring size: 3".
- C. When multiple binders are used, correlate the data into related groupings.
- D. Label contents on spine and face of binder with full size insert. Label under plastic cover.

PART 3 – EXECUTION

3.1 ELECTRICAL OPERATION AND MAINTENANCE MANUAL

- A. Form for 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 flyleaf 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.
 - 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 / 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
 - 1) List of lubricants required
 - e. Manufacturer's printed operating and maintenance instructions.
 - f. Copies of typed circuit directories of panel board to reflect actual room graphics numbers and room names (not architectural room numbers from the drawings).
 - 1) Electrical
 - 2) Controls
 - 3) Communications
 - 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. Schedule of fuses
 - i. Complete equipment field accessible internal wiring diagrams
 - j. Schedule of lamps
 - k. Schedule of ballasts
 - l. Each Contractor's coordination drawings
 - 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 26.
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.

END OF SECTION

SECTION 26 05 00 - ELECTRICAL GENERAL PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Except as modified in this Section, General Conditions, and Supplementary Conditions, applicable provisions of Division 1 General Requirements, and other provisions and requirements of the Contract Documents apply to work of Division 26 Electrical.
- B. Applicable provisions of this section apply to all sections of Division 26, Electrical.

1.2 CODE REQUIREMENTS AND FEES

- A. Perform work in accordance with applicable statutes, ordinances, codes and regulations of governmental authorities having jurisdiction.
- B. Electrical work shall comply with applicable inspection services:
 - 1. Underwriters Laboratories
 - 2. National Fire Protection Association
 - 3. State Health Department
 - 4. Local Municipal Building Inspection Department adopted codes with amendments
 - 5. National Electrical Code with local amendments
 - 6. State Regulatory Agencies
 - 7. Where the project is located outside a municipal jurisdiction, and has no municipal inspection services, the National Electrical Code with amendments of the municipality with extraterritorial jurisdiction shall govern.
 - 8. Where the project is located outside any municipal jurisdiction, including extraterritorial jurisdictions, the National Electrical Code with local adopted amendments of the largest municipality located in the same county or parish shall govern.
 - 9. International Energy Conservation Code
 - 10. National Electrical Safety Code
- C. Resolve any code violations discovered in contract documents with the Engineer prior to award of the contract. After Contract award, any correction or additions necessary for compliance with applicable codes shall be made at no additional cost to the Owner.
- D. This Contractor shall be responsible for being aware of and complying with asbestos NESHAP regulations, as well as all other applicable codes, laws and regulations.
- E. Obtain all permits required.

1.3 CONTRACTOR'S QUALIFICATIONS

- A. An approved contractor for the work under this division shall be:
 - 1. A specialist in this field and have the personnel, experience, training, and skill, and the 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 has served their Owners

satisfactorily for not less than 3 years.

1.4 REFERENCE SPECIFICATIONS AND STANDARDS

- A. Materials which are specified by reference to Federal Specifications; ASTM, ASME, ANSI, APWA, or AWWA Specifications; Federal Standards; or other standard specifications must comply with latest editions, revisions, amendments or supplements in effect on date proposals are received. Referenced specifications and standards are minimum requirements for all equipment, material and work. In instances where specified capacities, size or other features of equipment, devices or materials exceed these minimums, meet specified capacities.
- B. Use electrical materials and equipment that is constructed and tested in accordance with the standards of NEMA, ANSI, ASTM, or other recognized commercial standard. If materials and equipment is labeled, listed, or recognized by any Nationally-Recognized Testing Laboratory (NRTL) acceptable to the Occupational Safety and Health Administration (OSHA), then provide NRTL-labeled, listed, or recognized material and equipment. Acceptable NRTLs include but are not limited to:
1. Underwriters Laboratories, Inc. (UL)
 2. Factory Mutual Research Corp. (FMRC) (also referred to as "Factory Mutual Global," or "FM Global")
 3. Intertek Testing Services NA, Inc. (ITSNA, formerly ETL)
 4. Canadian Standards Association (CSA)
 5. A complete listing of acceptable NRTLs is published on the OSHA website at <http://www.osha.gov/dts/otpca/nrtl/>.
- C. Where material and equipment is not labeled, listed, or recognized by any NRTL, provide a manufacturer's Certificate of Compliance indicating complete compliance of each item with applicable standards of NEMA, ANSI, ASTM, or other recognized commercial standard.
- D. Do not install or use electrical material or equipment for any use other than that for which it was designed, labeled, listed, or identified unless formally approved for such use by the Owner's AHJ. This *National Electrical Code*® requirement is re-stated for emphasis.
- E. Codes and Standards applicable to this Division:
1. ANSI – American National Standards Institute
 - a. ANSI Z535.1, Safety Colors
 - b. ANSI Z535.2, Environmental and Facility Safety Signs
 - c. ANSI Z535.3, Criteria for Safety Symbols
 - d. ANSI Z535.4, Product Safety Signs and Labels
 2. ASHRAE – American Society of Heating, Refrigeration, and Air Conditioning Engineers:
 - a. ASHRAE Standard 90.1, *Energy Standards for Buildings Except for Low Rise Residential Buildings [ANSI, IESNA]*
 3. ASTM – American Society for Testing and Materials
 4. CBM – Certified Ballast Manufacturers
 5. ICC – International Code Council
 - a. International Building Code® (IBC)
 - b. International Existing Building Code® (IEBC)
 6. ICEA – Insulated Cable Engineers Association
 - a. ICEA S-93-639, *Shielded Power Cables 5-46kV (NEMA WC-74)*

7. IEEE® - Institute of Electronics and Electrical Engineers
 - a. IEEE C2™, *National Electrical Safety Code (NEC)* [ANSI]
 - b. IEEE Std 141™, *Recommended Practice for Electric Power Distribution for Industrial Plants* (“Red Book”)
 - c. IEEE Std 143™, *Recommended Practice for Grounding of Industrial and Commercial Power Systems* (“Green Book”)
 - d. IEEE Std 241™, *Recommended Practice for Electric Power Systems in Commercial Buildings* (“Gray Book”)
 - e. IEEE Std 242™, *Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems* (“Buff Book”)
 - f. IEEE Std 315™, *Graphic Symbols for Electrical and Electronics Diagrams*
 - g. IEEE Std 399™, *Recommended Practice for Power Systems Analysis* (“Brown Book”)
 - h. IEEE Std 446™, *Recommended Practice for Emergency and Standby Power Systems for Industrial and Commercial Applications* (“Orange Book”)
 - i. IEEE Std 493™, *Recommended Practice for the Design of Reliable Industrial and Commercial Power Systems* (“Gold Book”)
 - j. IEEE Std 519™, *Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems*
 - k. IEEE Std 739™, *Recommended Practice for Energy Management in Industrial and Commercial Facilities* (“Bronze Book”)
 - l. IEEE Std 902™, *Guide for Maintenance, Operation, and Safety of Industrial and Commercial Power Systems* (“Yellow Book”)
 - m. IEEE Std 1015™, *Recommended Practice Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems* (“Blue Book”)
 - n. IEEE Std 1100™, *Recommended Practice for Powering and Grounding Electronic Equipment* (“Emerald Book”)
 - o. IEEE Std 1584™, *Guide for Performing Arc-Flash Hazard Calculations*
8. IESNA – Illuminating Engineering Society of North America
 - a. IESNA *Lighting Handbook*, Ninth Edition
 - b. IESNA RP-1, *American National Standard Practice for Office Lighting*
 - c. IESNA RP-7, *American National Standard Practice for Lighting Industrial Facilities*
9. NECA – National Electrical Contractors Association:
 - a. NECA 1, *Good Workmanship in Electrical Construction* [ANSI]
 - b. NECA 90, *Recommended Practice for Commissioning Building Electrical Systems* [ANSI]
 - c. NECA 100, *Symbols for Electrical Construction Drawings* [ANSI]
 - d. NECA 101, *Standard for Installing Steel Conduits (Rigid, IMC, EMT)* [ANSI]
 - e. NECA 104, *Recommended Practice for Installing Aluminum Building Wire and Cable* [ANSI]
 - f. NECA / NEMA 105, *Recommended Practice for Installing Metal Cable Tray Systems* [ANSI]
 - g. NECA 111, *Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC)* [ANSI]
 - h. NECA / NACNA 120, *Standard for Installing Armored Cable (Type AC) and Metal-Clad Cable (Type MC)*[ANSI]
 - i. NECA 202, *Recommended Practice for Installing and Maintaining Industrial Heat Tracing Systems* [ANSI]

- j. NECA 230, *Standard for Selecting, Installing and Maintaining Electric Motors and Motor Controllers* [ANSI]
- k. NECA 331, *Standard for Building and Service Entrance Grounding and Bonding*
- l. NECA 400, *Standard for Installing and Maintaining Switchboards* [ANSI]
- m. NECA 402, *Standard for Installing and Maintaining Motor Control Centers* [ANSI]
- n. NECA / EGSA 404, *Standard for Installing Generator Sets* [ANSI]
- o. NECA 407, *Recommended Practice for Installing and Maintaining Panelboards* [ANSI]
- p. NECA 408, *Recommended Practice for Installing and Maintaining Busways* [ANSI]
- q. NECA 409, *Recommended Practice for Installing and Maintaining Dry-Type Transformers* [ANSI]
- r. NECA 410, *Recommended Practice for Installing and Maintaining Liquid-Filled Transformers* [ANSI]
- s. NECA 411, *Recommended Practice for Installing and Maintaining Uninterruptible Power Supplied (UPS)* (ANSI)
- t. NECA 420, *Standard for Fuse Applications* [ANSI]
- u. NECA 430, *Standard for Installing Medium-Voltage Metal-Clad Switchgear* [ANSI]
- v. NECA / IESNA 500, *Recommended Practice for Installing Indoor Lighting Systems* [ANSI]
- w. NECA / IESNA 501, *Recommended Practice for Installing Exterior Lighting Systems* [ANSI]
- x. NECA / IESNA 502, *Recommended Practice for Installing Industrial Lighting Systems* [ANSI]
- y. NECA / MACSCB 600, *Recommended Practice for Installing and Maintaining Medium-Voltage Cable* [ANSI]
- z. NECA / NEMA 605, *Installing Underground Nonmetallic Utility Duct* [ANSI]
- 10. NEMA – National Electrical Manufacturers Association
- 11. NETA – International Electrical Testing Association, Inc.:
 - a. NETA ATS, *Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems*
 - b. NETA MTS, *Maintenance Testing Specifications for Electrical Power Distribution Equipment and Systems*
 - c. NETA ETT, *Standard for Certification of Electrical Testing Technicians* [ANSI]
- 12. NFPA – National Fire Protection Association:
 - a. NFPA 20®, *Standard for the Installation of Stationary Pumps for Fire Protection*®
 - b. NFPA 70™, *National Electrical Code*® (NEC®)
 - c. NFPA 70E, *Standard for Electrical Safety in the Workplace.*
 - d. NFPA 101®, *Life Safety Code*®
 - e. NFPA 110, *Standard for Emergency and Standby Power Systems*
 - f. NFPA 111, *Standard on Stored Electrical Energy Emergency and Standby Power Systems*
 - g. NFPA 780, *Standard for the Installation of Lightning Protection Systems*
 - h. All other NFPA codes and standards except NFPA 5000
- 13. OSHA – Occupational Safety and Health Administration
- 14. IECC – International Energy Conservation Code
- 15. ISO – International Organization for Standardization

16. State and Local Energy Conservation Code
17. Applicable County and Municipal Codes

1.5 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.
- B. Every effort has been made by the Engineer to indicate wiring of all receptacles, light fixtures, switches, telephone outlets, HVAC equipment, other equipment, elevator equipment, and all other devices / appliances requiring electrical power. It is the intent of the Engineer that all light fixtures be powered and controlled unless specifically noted on the plans; that all wiring devices (receptacles and direct connected equipment) be circuited to a power source of the correct voltage and that all HVAC, elevator equipment and other equipment be properly wired to the correct voltage power source; that all communications and security systems devices and equipment and all fire alarm system devices and equipment are installed, wired and systems are fully operational.
- C. It is the responsibility of the Contractor to review the construction drawings (reflected ceiling plans) for light fixtures, casework elevation details for electrical devices which are not indicated on the electrical drawings; to review the mechanical and plumbing documents and all other drawings to determine the electrical rough-ins for all equipment requiring power connections, and to include in their proposals the correct and complete electrical rough-ins for all of these items which were inadvertently not indicated on the electrical drawings, OR the Contractor shall specifically enumerate each item requiring electrical rough-in which is not specifically shown on the electrical drawings, and indicate the electrical provisions of these items as specifically excluded from his proposal.
- D. It is the responsibility of the Contractor to compare the scale of all electrical drawings with the scale of the architectural drawings and make adjustments to all electrical drawings which have the incorrect drawing scale so that his material takeoffs are not in error due to an incorrectly labeled drawing scale and his proposal is complete.
- E. No proposal shall be accepted which specifically excludes any of the provisions of paragraphs B, C, or D above.

1.6 PROJECT RECORD DOCUMENTS

- A. Maintain at the job site a separate set of white prints (black line) of the contract drawings for the sole purpose of recording the "as-built" changes and diagrams of those portions of work in which actual construction is significantly at variance with the contract drawings. Mark the drawings with a colored pencil. Prepare, as the work progresses and upon completion of work, reproducible drawings clearly indicating locations of various major and minor feeders, equipment, and other pertinent items, as installed. Record underground and under slab service and feeders installed, dimensioning exact location and elevation of such installations.
- B. At conclusion of project, obtain without cost to the Owner, electronic PDF and AutoCAD 2014 and / or Revit CAD files of the original drawings and transfer as-built changes to these. Provide the following as-built documents including all contract drawings regardless of whether corrections were necessary and include in the transmittal: "2 sets of CDs and prints for Owner's use, one set of CDs, prints, and

mylars for Architect / Engineers Records". Delivery of these as-built electronic, reproducible and prints is a condition of final acceptance.

1. 3 sets of electronic AutoCAD (2014 dwg) and / or Revit CAD drawing files, on CD-ROM media, of each contract as-built drawing.
 2. One reproducible Dayrex Mylar film positive of each contract as-built drawing.
 3. Three sets of blue-line prints of each contract as-built drawing.
 4. Three sets of pdf prints of each contract as-built drawing on CD.
- C. 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 RECORD DRAWINGS.
 4. Clearly indicate: DOCUMENT PRODUCED BY:
 5. Indicate all changes to construction during construction. Indicate actual routing of all conduits, etc. that was deviated from construction drawings.
 6. Indicate exact location of all underground electrical raceways, and elevations.
 7. Correct schedules to reflect (actual) equipment furnished and manufacturer.
 8. During the execution of work, maintain a complete set of Drawings and specifications upon which all locations of equipment, devices, and all deviations and changes from the construction documents in the work shall be recorded.
 9. Exact location of all electrical equipment in building. Label panel schedules to indicate actual location.
 10. Exact location of all electrical equipment in and outside of the building.
 11. Exact location of all outdoor lighting poles and equipment.
 12. Location, size and routing of all feeder conduits, equipment, etc. shall be accurately and neatly shown to dimension.
 13. Exact location of all roof mounted equipment, wall, roof and floor penetrations.
 14. Cloud all changes.
 15. Update all panel schedules with all additional circuits added or deleted through construction. Identify each circuit to include all information specified for directory cards for circuit identification in panelboards.

1.7 SPACE REQUIREMENTS

- A. Consider space limitations imposed by contiguous work in selection and location of equipment and material. Do not provide equipment or material that is not suitable in this respect.

1.8 RELATION WITH OTHER TRADES

- A. Carefully study all matters and conditions concerning the project. Submit notification of conflict in ample time to prevent unwarranted changes in any work. Review other Divisions of these specifications to determine their requirements. Extend electrical services and final connections to all items requiring same.
- B. Because of the complicated relationship of this work to the total project, conscientiously study the relation and cooperate as necessary to accomplish the full intent of the documents.
- C. Provide sleeves and inserts in forms as required for the work. Stub up and protect open ends of pipe before any concrete is placed. Furnish sizes of required equipment pads. Furnish and locate bolts and fittings required to be cast in them.
- D. Locate and size openings required for installation of work specified in this Division in

sufficient time to prevent delay in the work.

- E. Refer to other Divisions of the specifications for the scope of required connections to equipment furnished under other Division. Determine from the General Contractor / Construction Manager for the various trades, the Owner, and by direction from the Architect / Engineer, the exact location of all items. The construction trades involved shall furnish all roughing-in drawings and wiring diagrams required for proper installation of the electrical work.
 - 1. Make final electrical connections to all electrically operated equipment indicated on the drawings, except as noted.
 - 2. The responsibility for alignment of motor and driven equipment is specified in the related division.
- F. Request all Shop Drawings required in ample time to permit proper installation of all electrical provisions.
- G. Extend services as indicated to the various items of equipment furnished by others. Rough-in for the various items and make final connections ready for operation upon placing of the equipment.

1.9 CONCEALED AND EXPOSED WORK

- A. When the word "concealed" is defined as hidden from sight as in chases, furred spaces or above ceilings. "Exposed" is defined as open to view, in plain sight.

1.10 GUARANTEE

- A. Guarantee work for 1 year from the date of substantial completion of the project. During that period make good any faults or imperfections that may arise due to defects or omissions in material, equipment or workmanship. Replacement of failed parts or equipment shall be provided.

1.11 MATERIAL AND EQUIPMENT

- A. Furnish new and unused materials and equipment meeting the requirements of the paragraph specifying acceptable manufacturers. Where two or more units of the same type or class of equipment are required, provide units of a single manufacturer.

1.12 NOISE AND VIBRATION

- A. Select equipment to operate with minimum noise and vibration. If noise or vibration is produced or transmitted to or through the building structure by equipment, piping, ducts or other parts of work, and judged objectionable by the Owner, Architect, or Engineer, rectify such conditions at no additional cost to the Owner. If the item of equipment is judged to produce objectionable noise or vibration, demonstrate at no additional cost that equipment performs within designated limits on a vibration chart.

1.13 ACCEPTABLE MANUFACTURERS

- A. Manufacturers names and catalog number specified under sections of Division 26 are used to establish standards of design, performance, quality and serviceability and not to limit competition. Equipment of similar design, materials, energy efficiency characteristics (where applicable) and lighting performance characteristics (where applicable) equal to that specified, manufactured by a named manufacturer shall be acceptable on approval. A request for prior approval of equipment not listed must be

submitted ten (10) days before proposal due date. Submit a marked-up set of the relevant specification section indicating all variances, a comparison to the specified product, and of construction and performance criteria, complete design and performance data for the specified product and the proposed substitution for comparison to the Engineer. The Architect issues approvals of acceptable manufacturers as addenda to the Construction Proposal Documents.

1.14 UTILITIES, LOCATIONS AND ELEVATIONS

- A. Locations and elevations of the various utilities included within the scope of this work:
 - 1. Obtained from utility maps and other substantially reliable sources.
 - 2. Are offered separate from the Contract Documents as a general guide only without guarantees to accuracy.
- B. Examine the site and verify the location and elevation of all utilities and of their relation to the work. Existing utilities indicated on the site plans are for reference only and shall be field verified by the Contractor with the respective public or private utility.

1.15 OPERATING TESTS

- A. After all electrical systems have been completed and put into operation, subject each system to an operating test under design conditions to ensure proper sequencing and operation throughout the range of operation. Tests shall be made in the presence of the Architect / Engineer and Owner. Provide minimum 24-hour advance notice of scheduling of all tests. Make adjustments as required to ensure proper functioning of all systems. Special tests on individual systems are specified under individual sections. Submit 3 copies of all certifications and test reports adequately in advance of completion of the work to allow for remedial action as required to correct deficiencies discovered in equipment and systems.

1.16 WARRANTIES

- A. All normal and extended warranties shall include parts, labor, miscellaneous materials, travel time, incidental expenses, normal freight / shipping, refrigerant, oils, lubricants, belts, filters and any expenses related to service calls required to diagnose and correct warranty problems.
- B. Manufacturer's warranty shall be from one year from date of substantial completion. Contractor shall be responsible for extending the warranties regardless of date of installation or commissioning.
- C. Submit 3 copies of all warranties and guarantees for systems, equipment, devices and materials. These shall be included in the Operating and Maintenance Manuals.

1.17 BUILDING CONSTRUCTION

- A. It shall be the responsibility of the sub-contractor to consult the Contract Drawings, details and specifications and thoroughly familiarize himself as to the construction and all job related requirements. All construction trades shall cooperate with the General Contractor / Construction Manager Job site superintendent and lay out work so that all raceways and other items are placed in the walls, furred spaces, chases, etc., so that there shall be no delay in the job.

1.18 TEMPORARY FACILITIES

- A. General: Refer to Division 1 for general requirements on temporary facilities.
- B. Temporary Wiring: Temporary power and lighting for construction purposes shall be provided under this Division. Installation of temporary power shall be in accordance with NEC Article 527.
- C. Temporary facilities, wire, lights and devices are the property of this Contractor and shall be removed by this Contractor at the completion of the Contract.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1 IDENTIFICATION OF EQUIPMENT

- A. Identification of Equipment:
 - 1. All major equipment shall have a manufacturer's label identifying the manufacturer's address, equipment model and serial numbers, equipment size, and other pertinent data. Take care not to obliterate this nameplate. The legend on all nameplates or tags shall correspond to the identification shown on the Operating Instructions. All panels, cabinets, or equipment requiring 120 volt or higher power shall be labeled as required which includes circuit designation and circuit panelboard location, regardless of which discipline installs the equipment.
 - 2. Three layer laminated plastic engraved identifying nameplate shall be permanently secured to each switchboard, distribution panel, motor control center, transformer, panelboard, safety disconnect switch, enclosed circuit breaker, transfer switches, remote generator transfer deices not installed inside light fixtures, wireway, busduct plug, terminal cabinet, surge protective device, capacitor, individual motor controller, contactor, fire alarm panels (main and remote booster), and communications (voice, data, video) cabinet or rack, security panels, time clocks, BMCS cabinets, sound reinforcement cabinets and racks, miscellaneous control cabinets, equipment integral disconnect switches, toggle or motor switches, disconnects for equipment, exterior junction boxes, exterior pull boxes, exterior wireways and gutters, and rooftop equipment (i.e.: supply and exhaust fans, rooftop HVAC equipment) with stainless steel screws.
 - a. Utility Power: White letters on black background
Generator Power (White letters on red background
UPS Power: White letters on blue background
Load Bank Circuits: White letters on green background
Solar or Wind Power Generation: White on orange background
 - b. Identifying nameplates shall have 1/2-inch high, engraved letters for equipment designation and 1/4-inch letters indicating source circuit designation, (i.e.: "PANEL HA –fed from MDP-6 located in Mech. Rm. 100"). The words "fed from" and "located" shall be included in the labeling.
Example: Panel HA
 Fed From MSB
 Located Main Elec. RM 100
Example: Disconnect for Panel LK
 Location: Kitchen
 Fed From Transformer TLK
 Located Main Elec. RM 100
 - c. Each switchboard, distribution panel, transfer switch, generator

- transfer device (GTD) for emergency lighting, and motor control center feeder or branch circuit device shall have a nameplate showing the load and location of load served in 1/4-inch high, engraved letters. Circuit breaker name and kirk key designation if applicable
- d. Each section of multiple section panelboards shall also indicate panelboard section number (i.e.: Panel "HA-Section 2 – fed from MDP-6 located in Mech. Rm. 100")
 - e. Motor Controllers, starters, and contactors: Provide neatly typed label inside each motor controller and contactor enclosure door identifying motor or load served, nameplate horsepower, full load amperes, code letter, service factor, and voltage / phase rating.
 - f. Individual motor controller and contactor nameplates shall include load served, location of load served, panel and circuit numbers serving load, location of panel serving load, panel and circuit number serving control circuit, location of panel serving control circuit (if different from panel serving load), description and location (if applicable) of control controlling contactor (i.e. Controlled: Switch in RM 100, and Controlled: BMCS). Contactor nameplate is to include whether it is a lighting or receptacle contactor and name of contactor. i.e. C-1.

| Lighting Contactor Example | Receptacle Contactor Example |
|---|---|
| Lighting Contactor C1 | Receptacle Contactor C2 |
| West Parking Lot Pole Lights | Table Recpts Lab Rm 100 |
| Fed From Panel HA-2,4,6 | Fed From Panel LA-2,4,6,8 |
| Located Main Elec. Rm. 100 | Located Mech. Rm. 110 |
| Control Circuit-Panel LA 42 | Control Circuit-Panel LA-42 |
| Located Main Elec. Rm. 100 | Controlled-Emer Shut Off Mushroom Switch Rm 101 |
| Controlled-BMCS | |
| GTD Example | |
| Exterior lighting wall packs / north soffit / west metal canopy | |
| Fed from Panels EHA-2 located in Elec. RM 105 and HA-1 via Lighting Contactor controlled by BMCS located in Elec. RM 200. | |

- g. Exterior J-boxes, pull boxes, and gutters shall have panel identification, circuit numbers, and location of panel listed on name plate. Low voltage shall be identified per contents, examples: DATA, BMCS, F/A
- h. Name plates on equipment served from switchboards, distribution

- panels, I-Line panels, and motor control centers are not to include circuit numbers shown on drawings as the circuit numbers are for construction drawing purposes only.
- i. Panel names for 277/480v shall start with the letter “H” and 120/208v, 120/240v shall start with the letter “L”. No panel shall be named to include a number other than multi sectional panels, example HA-section 2. New panels installed in renovation or site additions shall have names approved or designated by Owner’s electrical representative. Panel names shall not include the letter “I”. Transformer names shall start with the letter “T” followed by the panel name it serves, i.e. TLA.
 - j. Main service ATS label shall include equipment name, emergency source and location, normal power source and location, panel served and location. Wall mounted ATS serving lighting loads shall include type of lighting and location, emergency panel and circuit ID and location of panel, normal panel and circuit ID and location of panel.

| Main Service ATS Example | Wall Mounted Lighting ATS Example |
|---|---|
| ATS-1 | ATS |
| Emer Power-Emer Generator Located Chiller Yard | Exterior Wall Packs/Soffit Lights North/West Metal Canopy Lights |
| Normal Power-MSB Located-Mech Rm 100 | Fed from EHA-2 Located Mech Rm 200 |
| Serves Panel EHA Located-Mech Rm 100 | Fed From HB-4 Located Mech Rm 150 |
 - k. Name plates shall include rated bus amperage, voltage, number of phases, number of wires and type of essential electrical system as applicable.
 - l. Switchgear, switchboards, panelboards, motor control centers, or service equipment available fault current labeling: Provide a 2x3 inch permanently affixed (notice) label with white lettering on contrasting blue background permanently affixed to the equipment prior to energizing the equipment. The label shall include the date of installation and the date of calculation and comply with ANSI Z535.4 current standards design and durability. The date of calculation shall be the date indicated by the Engineer of Record’s seal on the Construction Documents. Example:
AVAILABLE FAULT CURRENT: ##, ### AMPS
DATE OF INSTALLATION: MM/DD/YY
DATE OF CALCULATION: MM/DD/YY
3. Cardholders and directory cards shall be furnished for circuit identification in panelboards. Cardholder shall be located on inside of panel door and shall be in a metal frame with clear plastic front. Circuit lists shall be typewritten. Circuit descriptions shall include explicit description and identification of items controlled by each individual breaker, including final graphics room number or name designation and name of each item served. If no building appointed room number or name is given, list locations per the following examples – A. Storage in Rm 100 – B. Office in Rm 100 – C. Storage west of Rm. 100. List corridors as “corridors”. Identify circuits controlled by contactors using a separate notation for each contactor used. List notation at bottom of schedule stating the circuits are controlled by a contactor, list exact location of contactor, and how switched. Do not use architectural room number designation shown on plans. Obtain final graphics room number identification from Architect’s final room number graphics plan. All locations served by breakers shall be listed on schedule. Panel schedule shall be large enough to contain all information required. Also refer to Section 26 24 16.

4. Permanent, waterproof, black markers shall be used to identify each lighting and power grid junction box, gutter and wireway. Clearly indicate the panel and branch circuit numbers available at that junction box, gutter or wireway. Where low voltage relay panels are used for lighting control, identify the low voltage relay panel and number in addition to the branch circuit panel and number.
 5. Pull Boxes, Transformers, Disconnect Switches, etc.: Field work each with a name plate showing identity, voltage and phase and identifying equipment connected to it. The transformer rating shall be shown on the panels or enclosures. For an enclosure containing a motor starter, the nameplate shall include the Owner's motor number, motor voltage, number of motor phases, motor load being serviced, motor horsepower, and motor full load current. Nameplates shall also indicate where panel is fed from.
- B. Prohibited Markings: Markings intended to identify the manufacturer, vendor, or other source from whom the material has been obtained are prohibited for installation in public, tenant, or common areas within the project. Also prohibited are materials or devices that bear evidence that markings or insignias have been removed. Certification, testing (example, Underwriters Laboratories), and approval labels are exceptions to this requirement.
- C. Warning Signs: Provide warning signs where there is hazardous exposure associated with access to or operation of electrical facilities. Provide text of sufficient size to convey adequate information at each location; mount permanently in an appropriate and effective location. Comply with industry standards for color and design.
- D. Wire and Cable Markers: Provide vinyl cloth markers with split sleeve or tubing type, except in manholes provide stainless steel with plastic ties.
- E. Wire and Cable Labeling: Provide wire markers on each conductor in all boxes, pull boxes, gutters, wireways, contactors, and motor controllers and load connection. Identify with panelboard / switchboard branch circuit or feeder number for power and lighting circuits, and with control wire number as indicated on equipment manufacturer's shop drawings for control wiring.
- F. Underground Warning Tape: Thomas and Betts or approved equal. Six-inch wide plastic tape, colored red for 50 volts or above electrical, or orange for communications and control with suitable warning legend describing buried electrical lines; telephone lines and data lines per APWA recommendations. All underground electrical conduits shall be so identified. Tape shall be buried at a depth of 6-inches below grade and directly above conduits or ductbanks. Provide magnetic marking tape below all underground electrical conduits.
- G. Lighting Controls and Equipment: Provide self-adhesive machine typed tape labels with $\frac{1}{4}$ " high white letters on $\frac{1}{2}$ " tall black background for digital lighting modules as "DLM". Modules or relays located above ceiling: adhere label to bottom of ceiling T-grid below relay location. Modules or relays located in mechanical or electrical rooms or other areas other than above ceiling: Adhere label to the cover of the module or relay and identify the area they control as "MAIN GYM", "BAND HALL", or "CORRIDOR 100", etc. Remote lighting control switches or push button stations located remotely from the area they control: Adhere label to device face plate, not obstructing screw fasteners, and intuitively identify function such as "GYM LTG LOW-HIGH" or "CAFE LTG DIM", etc.

3.2 CUTTING AND PATCHING

- A. General: Comply with the requirements of Division 1 for the cutting and patching of other work to accommodate the installation of electrical work. Except as authorized by the Architect / Engineer, cutting and patching of electrical work to accommodate the installation of other work is not permitted.

3.3 INSTRUCTION OF OWNER'S PERSONNEL

- A. Prior to substantial completion, conduct an on-site training program to instruct Owner's operating personnel in the operation and maintenance of the electrical systems.
 - 1. Provide the training during regular working day.
 - 2. The Instructors shall be experienced in their phase of operation and maintenance of the electrical systems and with the project.
 - 3. Refer to other specification sections for additional training and commissioning requirements.
- B. Time to be allocated for instructions.
 - 1. Minimum of 20 hours dedicated instructor time
 - 2. 4 hours on each of 5 days
 - 3. Additional instruction time for specific systems as specified in other Sections.
- C. Before on-site training, submit the program syllabus; proposed time and dates; for review and approval, minimum 48 hours prior to proposed training time and date.
 - 1. One copy to the Owner
 - 2. One copy to the Architect / Engineer
- D. The Owner shall provide a list of personnel to receive instructions, and shall coordinate their attendance at the agreed upon times.
- E. Use operation and maintenance manuals as the basis of instruction. Review manual with personnel in detail. 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 training. List time and date of each demonstration, hours devoted to the demonstration, and a list of people present, with their respective signatures.
- 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 Operating and Maintenance Manual.

3.4 OPENINGS

- A. Framed, cast or masonry openings for boxes, equipment or conduits are specified under other divisions. Drawings and layout work for exact size and location of all openings are included under this division.

3.5 HOUSEKEEPING PADS

- A. Provide concrete equipment housekeeping pads under all floor and outdoor mounted electrical equipment.
- B. Concrete and reinforcing steel shall be as specified in Division 3, or as indicated or noted.
- C. Concrete pads:
 - 1. 6-inches thick minimum indoors; 8-inches thick minimum outdoors, or match existing if indicated on the drawings to extend existing pads, or in other sections of the specifications.
 - 2. Chamfer strips at edges and corner of forms.
 - 3. Smooth steel trowel finish.
 - 4. Extend 3-inches minimum indoors beyond perimeter of equipment unless otherwise shown.
 - 5. 6-inch x 6-inch #8 wire reinforcement mesh.

3.6 OBSTRUCTIONS

- A. The drawings indicate certain information pertaining to surface and subsurface obstructions, which has been taken from available drawings. Such information is not guaranteed, however, as to accuracy of location or complete information.
 - 1. Before any cutting or trenching operations are begun, verify with Owner's representative, utility companies, municipalities, and other interested parties that all available information has been provided.
 - 2. Should obstruction be encountered, whether shown or not, alter routing of new work, reroute existing lines, remove obstruction where permitted, or otherwise perform whatever work is necessary to satisfy the purpose of the new work and leave existing services and structures in a satisfactory and serviceable condition.
- B. Assume total responsibility for and repair any damage to existing utilities or construction, whether or not such existing facilities are shown.

3.7 VANDAL RESISTANT DEVICES

- A. Where vandal resistant screws or bolts are employed on the project, deliver to the Owner 2 suitable tools for use with each type of fastener used, and 25 percent spare fasteners.
- B. Proof of delivery of these items to the Owner shall be included in the Operating and Maintenance Manuals.

3.8 PROTECTION

- A. Protect work, equipment, fixtures, and materials. At work completion, work must be clean and in original manufacturer's condition.
- B. Do not deliver equipment to this 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 shall be rejected, and the contractor is obligated to furnish new equipment of a like kind at no additional cost to the Owner.

3.9 COORDINATION OF BRANCH CIRCUIT OVERCURRENT AND PROTECTION DEVICES

- A. Review with equipment specified which requires electrical connections. Review equipment shop drawings and manufacturer's nameplate data and coordinate exact branch circuit overcurrent protective device and conductors with equipment provided.
 - 1. Provide equipment manufacturer's recommended overcurrent protective device indicated on nameplate at no additional cost to the Owner.
 - 2. If branch circuit conductors and / or conduit sizing is less than the minimum required by equipment manufacturer, notify the Architect / Engineer immediately, prior to rough-in.
 - 3. If equipment manufacturer is a substitution to the specified equipment manufacturer, provide the greater of the conductors specified or those required for the installed equipment manufacturer's minimum circuit conductors, at no additional cost to the Owner.
 - 4. If conductors indicated on plans are in excess of that permitted by equipment manufacturer, notify Architect / Engineer immediately, prior to rough-in.
 - 5. If conductors indicated on plans are in excess of that permitted by the equipment manufacturer, provide the maximum conductors permitted by the equipment manufacturer based on NEC ampacity tables, either in a single set, or as a set of parallel conductors as permitted by the NEC. Conductor size and quantity entering the equipment enclosures shall not exceed the equipment manufacturer's maximum recommendations.

3.10 FAULT CURRENT AND ARC FLASH STUDY FOR OVERCURRENT DEVICE COORDINATION

- A. Contractor shall provide a coordination study, fault current analysis, and Arc-Flash study report for new electrical distribution equipment downstream to the last new overcurrent device in each feeder or branch circuit, conducted and prepared by the switchgear manufacturer. The coordination study and fault current analysis shall include the manufacturer's recommendations for all adjustable overcurrent devices specified or provided. Study does not require inclusion of existing switchgear, except it shall include existing or new overcurrent devices in existing switchgear serving new switchgear. Contractor shall submit the report results prior to submitting switchgear submittals to allow changes or modifications to equipment selection.
- B. Contractor shall adjust all overcurrent device settings based on manufacturer's recommendations, or as directed by Owner / Architect at no additional cost to Owner. Settings for GFI shall be set at maximum as permitted by the NEC.
- C. Arc-Flash & Shock-Hazard Warning Labels: Provide arc-flash and shock hazard-warning labels that comply with ANSI Z535.4 on switchgear, switchboards, transformers, motor control centers, panelboards, motor controllers, safety switches, industrial control panels and other equipment that is likely to require examination, adjustment, servicing, or maintenance while energized. Locate the marking to be clearly visible to qualified persons before examination, adjustment, servicing, or maintenance of the equipment. On renovation projects, install arc-flash warning labels on existing equipment where lock-out / tag-out will be required for the renovation work. Provide the information listed below on each label. Specify that arc-flash warning label information be produced by the electrical equipment manufacturer or supplier as a part of the final power system studies to be submitted by the Contractor

in accordance with the electrical acceptance testing.

1. Note: In addition to the final arc-flash analysis, the final power system studies include load flow and fault-current calculations, and an overcurrent protective device (OCPD) coordination study based on the actual equipment to be installed for the project.

D. Information to be determined and applied to electrical equipment:

1. Arc-Flash Protection Boundary
2. Arc-Flash incident energy calculated in accordance with IEEE Std 15841™
3. Working distance calculated in accordance with IEEE Std 1584a™
4. NFPA 70E Hazard / Risk Category Number or the appropriate personal protective equipment (PPE) for operations with doors closed and covers on.
 - a. Typical operations include operating circuit breakers, fused switches, and meter selector switches.
5. System phase-to-phase voltage
6. Condition(s) when a shock hazard exists (e.g. "With cover off")
7. Limited Approach Boundary as determined from NFPA 70E, Table 130.2(C)
8. Restricted Approach Boundary as determined from NFPA 70E, Table 130.2(C)
9. Prohibited Approach Boundary as determined from NFPA 70E, Table 130.2(C)
10. Unique equipment designation or code (described under "Component Identification")
11. Class for insulating gloves based on system voltage (e.g., Class 00 up to 500V)
12. Voltage rating for insulated or insulating tools based on system voltage (e.g., 1000V)
13. Date that the hazard analysis was performed.
14. "Served from" circuit directory information including the serving equipment designation, location (e.g., room number), circuit number, and circuit voltage / number of phases / number of wires.
15. If applicable, the "serves" circuit directory information including the served equipment designation, location (e.g., room number), circuit number, and circuit voltage / number of phases / number of wires.
16. An abbreviated warning label may be used where it has been determined that no dangerous arc-flash hazard exists in accordance with IEEE 1584a™, paragraph 9.2.3.
17. Use a "DANGER" label where the calculated arc-flash incident energy exceeds 40 cal/cm.

- E. Submittals: Submit four copies of coordination study and certified fault current study results to the Architect for review.

3.11 EQUIPMENT BACKBOARDS

- A. Backboards: ¾ inch, fire retardant, exterior grade plywood, painted gray, both sides.
1. Provide minimum of two 4-ft. by 8-ft. sheets of plywood for each new telephone equipment terminal location.
 2. Provide minimum of two 4-ft. by 4-ft. sheets of plywood for each new data / voice / video / communications equipment location / cable TV head end equipment, or security equipment location.

3.12 TESTING

- A. The contractors for the various sub-systems shall submit proposed testing procedures for their systems, subject to review and approval and Owner acceptance. The contract

will not be declared to be substantially complete until the functional operation of the subsystems have been demonstrated and verified and reports have been provided, reviewed and accepted.

- B. The project will not be declared substantially complete until the following has taken place.
1. The "As-Built" drawings have been submitted, reviewed and accepted by the Architect / Owner / Owner's Construction Representative.
 2. The building emergency lighting system and other systems including but not limited to those listed below have been tested, completed factory start-up and programming and adjusting as required for a complete and fully operational system acceptable to the Architect and Owner.
 - a. Occupancy Sensor and Lighting Controls
 - b. Surge protective device equipment
 - c. Overcurrent devices
 - d. Motor Controllers
 - e. Emergency Lighting
 - f. Building Fire Alarm System

3.13 LOAD BALANCING

- A. Balance the loads on each low-voltage feeder so that the voltage on each phase is within +/- 1.0% of the average voltage of the three phases. Refer to the DOE Office of Industrial Technologies, "Motor Tip Sheet #7" dated September 2005 available for download to PDF format at no charge at:

http://www1.eere.energy.gov/industry/bestpractices/pdfs/eliminate_voltage_un_balanced_motor-systemts7.pdf

END OF SECTION

SECTION 26 05 05 - ELECTRICAL ALTERATIONS PROJECT PROCEDURES

PART 1 – GENERAL

1.1 WORK INCLUDED

- A. Inspection and service of existing equipment and materials to remain or be reused.
- B. Handling of equipment and materials to be abandoned.
- C. Handling of equipment and materials to be removed.

1.2 QUALITY ASSURANCE

- A. Coordination with the Contractor prior to the disconnection or shutdown of existing equipment, or to the modification of existing operational systems.

1.3 CONTRACT DRAWINGS

- A. There is the possibility that there exist conditions and devices that are affected by the work indicated on the drawings and called for in the specifications (project manual) that do not appear on the drawings. It is the Contractors responsibility to visit the site and determine all of the existing conditions and to consider these existing conditions when making and presenting a proposal, to have a complete proposal.

PART 2 – PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Material used to upgrade and repair existing equipment shall conform to that specified.
- B. Material used to upgrade and repair existing equipment shall not void existing warranties or listings of the equipment to be upgraded or repaired.
- C. Material used to upgrade and repair existing equipment shall be new and shall be of the same manufacturer of the existing equipment, shall be acquired through the existing original equipment manufacturer's approved distribution channels, shall have manufacturer's warranties for the new material being used, and shall be listed for the use intended.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Existing materials and equipment indicated on the drawings or in the specifications to be reused shall be inspected for damaged or missing parts. Notify the Architect / Engineer, in writing, accordingly.
- B. If using materials specified or shown on the drawing voids or diminishes the warranty or operation of remaining equipment or systems, the Contractor shall notify the Architect / Engineer, in writing.
- C. Verify field measurements and circuiting arrangements.
- D. Verify that abandoned wiring, panelboards, and switchboards, disconnect switches, and

equipment serve only abandoned facilities. Where abandoned wiring, panelboards, switchboards, and equipment which serve existing facilities are to remain, Contractor shall provide means and methods to ensure existing facilities remain energized with the correct voltage, overcurrent protection, conductors, and circuit ampacity required by the existing facilities to remain.

- E. Demolition Drawings are based on casual field observation, and when available, existing record documents. Report discrepancies to Architect before disturbing existing installation, and immediately after such discrepancies are discovered.

3.2 APPLICATION

- A. Existing materials and equipment indicated on the drawings or in the specification to be reused shall be cleaned and reconditioned, including tightening of feeder and bus bar lugs prior to installation and reuse in the modified system.
- B. Remove existing luminaries for alterations/renovations. Use mild detergent to clean all exterior and interior surfaces; rinse with clean water and wipe dry. For each luminaire that is taken down for alteration and then reinstalled, replace damaged parts, provide new lamps and, with matching paint, touch-up scratched or abraded areas, and replace cracked, broken or missing lenses or diffusers. Replace unrepairable fixtures with new fixtures.
- C. Material and equipment removed that is not to be salvaged for Owner's use or for reuse on the project shall become the property of the Contractor and shall be removed from the site.
- D. Prior to start of construction, Contractor shall walk areas to be renovated with Owner to identify and document items to be salvaged for Owner's use.
- E. Material or equipment salvaged for Owner's use shall be carefully handled and stored where directed by the Owner.
- F. Materials and equipment not indicated to be removed or abandoned shall be reconnected to the new system.
- G. Clean and repair existing materials and equipment that remain or are to be reused.
- H. Panelboards Reused and Modified for Renovation: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.

3.3 SEQUENCING AND SCHEDULING

- A. Coordinate utility service outages with Utility Company, Architect and Owner.
- B. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits use personnel experienced in such operations.
- C. Existing Electrical Service: Refer to drawings for work in remodeled areas. Where facilities in these areas are to remain in service, any related work to keep the facilities in operation is specified in this Division. Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and

connections. Obtain written permission from Owner at least 10 business days before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area. Disclose the extent, exact time and expected duration of the outage in a written request to the Owner.

- D. Remove and replace existing conduit, wiring, outlets, devices, lighting fixtures, panels and appurtenances as occasioned by new or remodeled construction. Re-establish service to lights, switches and devices that may be interrupted by remodeled construction.
- E. Disconnect electrical systems in walls, floors and ceilings scheduled for removal. When outlets are removed, wire shall be pulled out of the conduit back to the nearest remaining box or cabinet.
 - 1. Remove exposed conduit that has been abandoned.
 - 2. Cap conduit beyond the finish line.
 - 3. Provide unswitched circuit leg for emergency battery powered equipment; circuit from same branch circuit breaker as switched normal lighting circuit.
- F. Where new/existing luminaries or devices are shown being connected to existing circuits:
 - 1. Field verify existing system voltage
 - 2. Provide ballast / device to match system voltage
- G. Verify the loading of each circuit affected by remodeling work. The maximum load of any branch circuit shall not exceed 80% of its rating.
- H. Remove equipment, systems, conductors, wiring, raceways, etc. abandoned or not required for existing or new systems. Coordinate with Architect / Owner for salvage by Owner. Remove abandoned / not required raceways and wiring back to nearest box serving load to remain, or back to panel if not serving remaining load.
- I. Existing Power, and Lighting and Appliance Branch Circuit Distribution System: Maintain existing system in service unless as noted or specified otherwise. Disable system only to make switchovers and connections. Notify Owner at least 72 hours before partially or completely disabling system. Minimize outage duration. Make connections to maintain service in areas adjacent to work area.
- J. Existing Lighting System: Maintain existing system in service unless as noted or specified otherwise. Disable system only to make switchovers and connections. Notify Owner at least 72 hours before partially or completely disabling system. Minimize outage duration. Make connections to maintain service in areas adjacent to work area.
- K. Existing Fire Alarm System: Maintain existing system in service. Disable system only to make switchovers and connections. Notify Owner and local fire service at least 72 hours before partially or completely disabling system. Minimize outage duration. Make connections to maintain service in areas adjacent to work area.
- L. Existing Telephone System: Maintain existing system in service. Disable system only to make switchovers and connections. Notify Owner and Telephone Company at least 72 hours before partially or completely disabling system. Minimize outage duration. Make connections to maintain service in areas adjacent to work area.
- M. Existing Paging and Sound Reinforcement Systems: Maintain existing system in service. Disable system only to make switchovers and connections. Notify the Owner at least 72 hours before partially or completely disabling system. Minimize outage duration. Make connections to maintain service in areas adjacent to work area.

- N. Existing Data Network: Maintain existing system in service. Disable system only to make switchovers and connections. Notify the Owner at least 72 hours before partially or completely disabling system. Minimize outage duration. Make connections to maintain service in areas adjacent to work area.
- O. Existing Video Distribution System: Maintain existing system in service. Disable system only to make switchovers and connections. Notify the Owner at least 72 hours before partially or completely disabling system. Minimize outage duration. Make connections to maintain service in areas adjacent to work area.
- P. Existing Security System: Maintain existing system in service. Disable system only to make switchovers and connections. Notify the Owner at least 72 hours before partially or completely disabling system. Minimize outage duration. Make connections to maintain service in areas adjacent to work area.
- Q. Existing Video Surveillance System: Maintain existing system in service. Disable system only to make switchovers and connections. Notify the Owner at least 72 hours before partially or completely disabling system. Minimize outage duration. Make connections to maintain service in areas adjacent to work area.

3.4 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

- A. The Contractor shall modify, remove, and/or 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 the property of the Owner, and shall be delivered to such destination as directed by the Owner's representative unless they are not wanted, then it will be the responsibility of this Contractor to remove such items and properly dispose of them. Materials and/or items scheduled for relocation and which are damaged during dismantling or reassembly operations shall be repaired and restored to good operative condition. The Contractor may, at his discretion, and upon approval of the Owner's representative substitute new materials and/or items of like design and quality in lieu of materials and/or items to be relocated.
 - 1. Remove abandoned electrical distribution equipment, utilization equipment, outlets and accessible portions of wiring, raceway systems, and cables back to the source panelboard, switchboard, switchgear, communications closet, or cabinet. Abandoned wiring and raceways can result from actions that include the following:
 - a. Equipment is removed or relocated
 - b. Fixtures are removed or relocated
 - c. System is no longer used
 - d. There is no demonstrable near term future use for the existing circuit or raceway system.
 - 2. Leave abandoned electrical equipment, conductors, and material in place only if one or more of the following conditions exist:
 - a. The removal requires the demolition of other structures, finishes, or equipment that is still in use. An example is abandoned conduit above an existing plaster ceiling.
 - b. Removal is not feasible due to hazards, construction methods, or restricted access.
 - c. Removal of abandoned conductors may damage conductors that must remain operational.
 - 3. Remove conduits, including those above accessible ceilings, to the point that building construction, earth, or paving covers them. Cut conduit beneath or flush

- with building construction or paving. Plug, cap, or seal the remaining unused conduits. Install blank covers for abandoned boxes and enclosures not removed.
4. Extend existing equipment connections using material and methods compatible with the existing electrical installation and this division.
 5. Restore the original fire rating of floors, walls, and ceilings after electrical demolition.
 6. Use approved lock-out / tag-out procedures to control hazardous energy sources. Assure that an electrically safe work condition exists in the demolition area before beginning demolition. Where possible, disconnect the building from all sources of electrical power before beginning demolition.
- B. All items 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 relocations and to restore them 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.
- C. When items scheduled for relocation and/or reuse are found to be in damaged condition before work has been started on dismantling, the Contractor shall call the attention of the Owner's representative to such items and receive further instructions before removal. Items damaged in repositioning operations are the contractor's responsibility and shall be repaired or replaced by the contractor as approved by the owner's representative, at no additional cost to the Owner.
- D. Conduit and wiring to items to be removed, salvaged, or relocated shall be removed to points indicated on the drawings, specified, or acceptable to the Owner's representative. Conduit 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 disconnected in a safe manner acceptable to the Construction Inspector. All disconnections or connections into the existing facilities shall be done in such a manner as to result in minimum interruption of services to adjacent occupied areas. Services to existing areas or facilities that must remain in operation during the construction period shall not be interrupted without prior specific approval of the Owner's representative hereinbefore specified.
- E. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets that are not removed. Replace existing wiring devices and cover plates with new wiring devices and new cover plates in renovated areas. Any corridor, room, or area indicated to have any new wiring devices installed shall have all of the existing wiring devices and cover plates replaced with new wiring devices and new cover plates.
- F. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.
- G. Disconnect and remove abandoned luminaries. Remove brackets, stems, hangers, and other accessories.
- H. Repair adjacent construction and finishes damaged during demolition and extension work.
- I. Maintain access to existing electrical installations that remain active. Modify installation or provide access panel as appropriate.
- J. Extend existing installations using materials and methods compatible with existing electrical installations, or as specified.

- K. Existing conduit raceway found to need additional hangers installed and/or junction box covers shall be added at no additional cost to the Owner.
- L. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.

3.5 PROTECTION OF THE WORK

- A. Provide adequate temporary support and auxiliary structure as necessary to ensure structural value or integrity of affected portion of work.
- B. Provide devices and methods to protect other portions of work from damage.
- C. Execute fitting and adjustment of products to provide a finished installation to comply with specified products, functions, tolerances and finishes.

3.6 IDENTIFICATION OF EQUIPMENT IN RENOVATED AREAS

- A. Identification of Equipment: Provide new, typed panel directory cards (and card holders if needed) for existing panelboards located within the renovated areas. Ring out all new and existing circuits within these panelboards as specified in Section 26 05 00 Electrical General Provisions. Do not include the description "existing". Provide new nameplates for all existing electrical equipment in renovated areas as specified in Section 26 05 00 Electrical General Provisions.

3.7 CORRECTIVE MEASURES FOR DAMAGE DURING CONSTRUCTION IN EXISTING LOW VOLTAGE SYSTEMS

- A. Repairs, equipment replacements, and corrections to low voltage systems due to damage caused by contractor:
 - 1. Notify the Owner immediately of any disruption or damage to any low voltage system.
 - 2. Any disruption or damage to the existing access control system or fire alarm system shall be corrected the same day as the disruption or damage occurred. The access control system and fire alarm system shall be tested daily in the presence of the owner prior to the Contractor leaving the job site each day.
 - 3. For each low voltage system a manufacturer certified contractor and certified technicians shall perform corrective measures to each system component that was functional prior to demolition and renovation and found defective or non-functional within 14-days prior to estimated date of substantial completion.
 - 4. Corrective measures to all low voltage systems to correct components of the low voltage systems found damaged by the contractor shall be completed to the satisfaction of the Owner and Architect / Engineer prior to acceptance of substantial completion at no additional cost to the Owner.

END OF SECTION

SECTION 26 05 10 - CONTRACT QUALITY CONTROL

PART 1 – GENERAL

1.1 WORK INCLUDED

- A. Contract quality control including workmanship, manufacturer's instructions, mock-ups and demonstrations.

1.2 QUALITY CONTROL PROGRAM

- A. Maintain quality control over supervision, subcontractors, suppliers, manufacturers, products, services, site conditions and workmanship to produce work in accordance with contract documents. Submit a narrative outline of the Quality Control Program or Plan.

1.3 WORKMANSHIP

- A. Comply with industry standards except when more restrictive tolerances or specified requirements indicate more rigid standards or more precise workmanship.
- B. Perform work by persons qualified to produce workmanship of specified quality. Persons performing electrical work shall be required to be licensed. There shall be on-site supervision at all times, including punch list work, with that person having a minimum of journeyman license. Helpers, apprentices shall have a minimum of apprentice license.
- C. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, and racking. Under no conditions shall material or equipment be suspended from structural bridging.
- D. Provide finishes matching approved samples; all exposed finishes shall be approved by the Architect / Engineer. Submit color samples as required.

1.4 MANUFACTURER'S INSTRUCTIONS

- A. Comply with instructions in full detail, including each step in sequence.
- B. Should instruction conflict with Contract Documents, request clarification from Architect / Engineer before proceeding.

1.5 MANUFACTURER'S CERTIFICATES

- A. When required in individual Specification Sections, submit manufacturer's certificate in duplicate, certifying that products meet or exceed specified requirements.

1.6 MANUFACTURER'S FIELD SERVICES

- A. When required in individual Specification Sections, manufacturer shall provide manufacturer's qualified personnel to observe:
 - 1. Field conditions
 - 2. Condition of installation
 - 3. Quality of workmanship
 - 4. Start-up of equipment
 - 5. Testing, adjusting, and balancing of equipment
- B. Manufacturer's qualified personnel shall make written report of observations and

recommendations to Architect / Engineer.

1.7 MOCKUPS

- 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 where possible.
- D. Perform tests and submit results as specified.

1.8 SCHEDULING OF MOCK-UPS

- A. Schedule demonstration and observation of mock-ups, in phases, with Architect / Engineer.
 - 1. Rough-in
 - 2. Finish with all appurtenances in place
 - 3. Demonstrations
- B. Refer to other specification sections for pre-functional checklist for requirements to aid in preparing mock-ups.

PART 2 – PRODUCTS

2.1 EQUIPMENT AND MATERIAL

- A. Comply with recognized National rating and approval agencies as well as all codes and ordinances at the federal, state and city levels.

PART 3 – EXECUTION

3.1 ADJUSTMENTS AND MODIFICATIONS

- A. Contractor shall provide all adjustments and modifications as requested by the manufacturer's qualified personnel at no additional cost to Owner.
- B. Coordination Drawings:
 - 1. Electrical room size and location required and to scale
 - 2. Equipment and accessories, switchgear and piping
 - 3. Indicate clearances and service access.

3.2 ELECTRICAL ACCEPTANCE TESTING

- A. Perform electrical acceptance testing and inspections in accordance with the current edition of the International Electrical Testing Association (NETA), *Acceptance Testing Specification (ATS)*.
- B. Perform acceptance testing, inspection, function tests, and calibration to assure that installed electrical systems and components, both Contractor and user-supplied are:
 - 1. Installed in accordance with design documents and manufacturer's instructions.
 - 2. Tested and inspected in accordance with applicable codes and standards (e.g. NFPA 110 and NFPA 111).

3. Ready to be energized.
4. Operational within industry and manufacturer's tolerances.

3.3 INSPECTIONS BY LOCAL AUTHORITY HAVING JURISDICTION (AHJ)

- A. Contractor shall notify design prime consultant and associated Architect / Owner's Construction Manager when he requests an inspection by the AHJ.

3.4 MOCK-UPS

- A. Mock up the light fixture fireproofing for each type of light fixture to be located in fire rated ceilings. Demonstrate that the fire proofing material does not interfere with the mechanical operation of light fixture doors, hinges, or latches.
- B. Mock up a typical classroom, science lab of each type, and computer lab with all wiring devices, all lighting controls, covers plates, rough-in boxes, conduits, MC cables, etc. Provide all conductors from all wiring devices to above ceiling space to demonstrate conduit or MC Cable routing and conductor fill.
- C. Mock up a typical panelboard backbox with Surge Protective Device (SPD) panelboard extension backbox or SPD device.
- D. Mock up ten feet of cable tray including all supports, hardware and bonding.

END OF SECTION

**SECTION 26 05 12 - ELECTRICAL SHOP DRAWINGS, COORDINATION DRAWINGS
& PRODUCT DATA**

PART 1 – GENERAL

1.1 WORK INCLUDED

- A. Prepare submittals as required by Division 01 and as outlined below.
- B. Provide individual submittals based on the project specification section number and description and only items specified or required in that specific project specification section.
- C. Submit product data shop drawings only for the following items indicated below when included as part of the project specifications, and for items specifically requested elsewhere in the Contract Drawings and Specifications. Architect / Engineer reserves the right to refuse shop drawings not requested for review, typically for basic materials and commodity off-the-shelf materials, and/or to imply that materials shall be provided as specified without exception.
- D. The term submittal, as used herein, refers to all:
 - 1. Shop Drawings
 - 2. Coordination Drawings
 - 3. Product data
- E. Submittals shall be prepared and produced for:
 - 1. Distribution as specified
 - 2. Inclusion in the Operating and Maintenance Manual, in the related O&M manual section.

1.2 ARCHITECT / ENGINEER REVIEW OF SUBMITTALS

- A. The Architect / Engineer will:
 - 1. Review requested submittals with reasonable promptness. Specific equipment submittal within a materials specification section that may be required to be expedited shall be submitted separately without other submittal items not requiring the same prompt attention.
 - 2. Affix stamp and initials or signature and indicate requirements for resubmittal or exceptions to submittal as submitted.
 - 3. Return submittals to Contractor for distribution or for resubmission.
- B. Review of submittals will not extend to design data reflected in submittals that is peculiarly within the special expertise of the Contractor or any party dealing directly with the Contractor.
- C. Architect / Engineer's review is only for conformance with the design concept of the project and for compliance with the information given in the contract.
 - 1. The review shall not extend to means, methods, sequences, techniques or procedures of construction or to safety precautions or programs incident thereto.
 - 2. The review shall not extend to review of quantities, dimensions, weights or gauges, fabrication processes, or coordination with the work of other trades.
- D. The review of a separate item as such will not indicate approval of the assembly in which the item functions.

1.3 SUBSTITUTIONS

- A. Do not make requests for product or material substitution employing the procedures of this Section. The procedure for making a formal request for substitution is specified in Division 01.

PART 2 – PRODUCTS

- A. Each individual submittal shall be an individual specific electronic data file with the file name resembling the product specification section number and title. Refer to Division 01 for additional data file format and media requirements.

PART 3 – EXECUTION

3.1 SPECIFICATION COMPLIANCE REVIEW

- A. Do not submit an outline form of compliance, submit a complete copy with the product data.
- B. Mark up a complete copy of the complete specification section for the product to indicate a) acknowledgement of the specification requirement (Comply), or b) acknowledgement that the particular specification requirement does not apply to this specific project (Not Applicable) or, c) acknowledgement that the specification requirement cannot be made or that a variance is being submitted for review to the Architect / Engineer / Owner (Does Not Comply, Explanation:).
- C. Variances for product or materials typically include updated model numbers or updated versions of the specified product from the same manufacture or an equal or better product from the approved manufactures list. Substitutions from manufacture's not on the approved manufacture's will not be reviewed unless prior approval using one of the procedures for substitutions or changes in the contract documents are followed as required in Division 01.

3.2 COMPOSITE COORDINATION DRAWINGS

- A. Produce a set of composite coordination drawings for above ceiling, below ceiling, and below floor of electrical, mechanical, and technology equipment rooms and equipment yards for review and comment within four (4) weeks of receipt of Owner's official Notice to Proceed. Show coordination of items including but not limited to structural and architectural elements, all mechanical and plumbing piping, ductwork, equipment, electrical conduit, low voltage communications and safety/security systems cabling, cable trays, lighting, electrical switchgear, generators and UPSs, and any public or private building utility services.
 - 1. Prepare the composite plans at one-quarter inch (1/4") equals one-foot scale. Include larger scale sections with vertical elevations of elements as required to confirm coordinate of all elements.
 - 2. For each room containing major electrical switchgear and each outside equipment area with major electrical switchgear and other equipment also include NEC working space, NEC equipment space, and NEC access to NEC working space, and housekeeping pad location and dimensions.
 - 3. Prepare coordination drawings to coordinate installations for efficient use of available space allowing for future additional equipment wherever possible, for proper sequence of installation, and to resolve conflicts. Coordinate with work specified in other sections and other divisions of the specifications.

4. Identify field dimensions. Show relation to adjacent or critical features of work or products.
- B. Submit composite coordination shop drawings in plan, elevation and sections, showing receptacles, outlets, electrical and telecommunication devices in casework, cabinetwork and built-in furniture.
1. Verify location of wiring devices and outlets, communication devices and outlets, safety and security devices, and other work specified in this Division.
 2. Coordinate with drawing details, site conditions, composite coordination drawings, and millwork other equipment shop drawings prior to installation.
 3. Submit coordination and shop drawings prior to rough-in and fabrication.

3.3 EQUIPMENT SHOP DRAWINGS AND PRODUCT DATA

- A. Submittals shall not be combined or bound together with any other material submittal. Do not submit entire product catalogs, submit only specific data sheets indicating required product information and available product options or accessories.
- B. Submittal Specification Information:
1. Every submittal document shall bear the following information as used in the project manual:
 - a. The related specification section number
 - b. The exact specification section title
 - c. Additional identifiers as required in Division 01.
 2. Submittals delivered to the Architect / Engineer without the specified information will not be processed. The Contractor shall bear the risk of all delays, as if no submittal had been submitted or delivered.
- C. All product options specified shall be clearly indicated on the product data submittal. All options listed on the standard product printed data not clearly identified as either part of or not part of the product data submitted shall become part of the Contract and shall be assumed to be provided with the product submitted.
- D. Mark each copy of standard manufacturer's printed data to identify pertinent products, referenced to specification section and article number.
- E. Show reference standards, performance characteristics and capacities; wiring diagrams and controls; component parts; finishes; dimensions and required clearances.
- F. Modify manufacturer's standard schematic drawings and diagrams to supplement standard information and to provide information specifically applicable to the work. Delete or strike through information not applicable.
- G. Submit drawings in a clear and thorough manner. Identify details by reference to sheet and detail, schedule, or room numbers shown on Contract Drawings.
- H. Show all dimensions of each item of equipment in its to be installed assembled condition with all components assembled. Include a series of drawings of individual components as necessary for reference.
- I. Identify field dimensions; show relation to adjacent or critical features or work or products.
- J. Submit individually bound shop drawings and product data for the following when

specified or provided.

- K. The Fault Current and Overcurrent Device Coordination Analysis shall be submitted prior to other electrical switchgear dependent on the results of the study for specific product selection by the vendor or contractor for compliance with the study.
 - 1. The emergency life safety power system equipment shall be fully coordinated as required by the NEC.
 - 2. The AIC and WCR ratings of all products meet or exceed the available fault current at that equipment's location.
 - 3. Electrical systems other than life safety power systems shall be coordinated as much as practicable while reducing arc flash energy as much as practical.

- L. Required submittals when products are indicated or specified:
 - 1. Fault Current and Overcurrent Device Coordination Analysis. Submit this analysis three (3) weeks prior to any overcurrent device submittal to allow modifications to overcurrent device product selection submittal based on the manufacture's analysis and recommendations at no additional cost to the Owner.
 - 2. Enclosed Switches and Circuit Breakers
 - 3. Enclosed Motor Controllers
 - 4. Panelboards, load centers, and enclosures
 - 5. Wiring devices
 - 6. Lighting fixtures
 - 7. Lighting Controls and Occupancy Sensors
 - 8. Surge Protection Devices
 - 9. Site Lighting Poles, Fixtures, Drivers, and Lamps
 - 10. Electrical controls and time switches
 - 11. Electrical Contactors
 - 12. Motor control centers
 - 13. Transformers
 - 14. Switchboards
 - 15. Metering equipment for energy monitoring and usage
 - 16. Emergency/Standby generator sets and transfer switches
 - 17. Surface Raceways
 - 18. Architectural Dimming Systems
 - 19. Theatrical Lighting Systems
 - 20. Sports Lighting Equipment, Fixtures, Poles

3.4 MANUFACTURERS INSTRUCTIONS

- A. Submit Manufacturer's instructions for storage, preparation, assembly, installation, start-up, adjusting, calibrating, balancing and finishing.

3.5 CONTRACTOR RESPONSIBILITIES

- A. Review, make corrections or annotations for clarification of manufacturer supplied data, stamp and sign submittals prior to transmittal.

- B. Determine and verify:
 - 1. Field measurements
 - 2. Field construction criteria
 - 3. Manufacturer's catalog numbers
 - 4. Conformance with the Contract Documents

- C. Coordinate submittals with requirements of the work and of the Contract Documents.

- D. Notify the Architect / Engineer in writing at time of submission of any deviations in the submittals from requirements of the Contract Documents.
- E. Do not fabricate products, or begin work for which submittals are required, until such submittals have been produced and bear contractor's stamp of acceptance or approval. Do not fabricate products or begin work until return of reviewed submittals with Architect / Engineer's acceptance.
- F. Contractor's responsibility for errors, omissions, or un-approved substitutions in submittals is not relieved whether Architect / Engineer reviews submittals or not.
- G. Contractor's responsibility for deviations in submittals from requirements of Contract Documents is not relieved whether Architect / Engineer reviews submittals or not, unless Architect / Engineer gives written acceptance of the specific deviations identified by the Contractor on reviewed documents.
- H. Submittals shall show sufficient data to indicate complete compliance with Contract Documents:
 - 1. Proper sizes and capacities
 - 2. That the item will fit in the available space in a manner that will allow proper service; manufacture's and code required clearances.
 - 3. Construction methods, materials and finishes
- I. Schedule submissions at least 15 days before date reviewed submittals will be needed by the Contractor for processing or for making corrections for re-submittal.
- J. General and Electrical Contractor's Stamp of Approval
 - 1. The general contractor and the electrical contractor shall stamp and sign each document certifying to the review of products, field measurements and field construction criteria, and coordination of the information within the submittal with requirements of the work and of Contract Documents.
 - 2. Contractor's stamp of approval on any submittal shall constitute a representation to Owner and Architect / Engineer that Contractor has either determined and verified all quantities, dimensions, field construction criteria, materials, catalog numbers, and similar data or assumes full responsibility for doing so, and that Contractor has reviewed or coordinated each submittal with the requirements of the work and the Contract Documents.
 - 3. Do not deliver any submittals to the Architect / Engineer that do not bear the Contractor's stamp of approval and signature.
 - 4. Submittals delivered to the Architect / Engineer without Contractor's stamp of approval and signature will not be processed. The Contractor shall bear the risk of all delays, as if no submittal had been delivered.

3.6 SUBMISSION REQUIREMENTS

- A. Make submittals promptly in accordance with approved schedule, and in such sequence as to cause no delay in the Project or in the work of any other Contractor. Product and equipment related to site work or other trades which require extensive rough-in, foundations, or structural support shall be submitted as soon as possible after given notice to proceed with construction.
- B. Number of submittals required:
 - 1. Coordination Drawings: Submit one electronic data file (pdf) and three opaque

- reproductions or coordination drawings.
2. Product Data: Submit electronic data PDF files. Refer to Division 01 for specific requirements. PDF files that are 20MB or larger may indicate that a submittal includes information not specifically relevant to the specific product being provided, information not required for the review of the specific product such as a complete product catalog or catalog section. Contractor shall include only the product data required to review the specific products characteristics for compliance with the contract documents.
- C. Accompany submittals with transmittal letter containing:
1. Date
 2. Project title and number
 3. Contractor's name, address and contact information.
 4. The number of each Shop Drawing, Project Datum and Sample submitted
 5. Other pertinent data as required in Division 01.
- D. Submittals shall include:
1. The date of submission
 2. The project title and number
 3. Contract Identification
 4. The names of:
 - a. Contractor
 - b. Subcontractor
 - c. Supplier
 - d. Manufacturer
 5. Identification of the product
 6. Field dimensions, clearly identified as such
 7. Relation to adjacent or critical features of the work or materials
 8. Applicable standards
 9. Identification of deviations from contract documents
 10. Suitable blank space for General Contractor and Architect / Engineer stamps
 11. Contractor's signed and dated Stamp of Approval.
- E. Coordinate submittals into logical groupings to facilitate interrelation of the several items.
1. Finishes which involve Architect / Engineer selection of colors, textures or patterns
 2. Associated items requiring correlation for efficient function or for installation

3.7 RESUBMISSION REQUIREMENTS

- A. Make resubmittals under procedures specified for initial submittals. Re-submittals shall be a complete submittal as if it were the initial submittal unless otherwise instructed in the review comments on the original submittal.
1. Indicate that the document or sample is a resubmittal
 2. Identify changes made since previous submittals
- B. Indicate any additional changes which have been made by the contractor other than those requested by the Architect / Engineer.

END OF SECTION

SECTION 26 05 19 - CONDUCTORS AND CONNECTORS – 600 VOLT

PART 1 – GENERAL

1.1 WORK INCLUDED

- A. Provide electrical conductors, wire and connector work as shown and specified manufactured in the USA.
- B. Types: The types of conductors and connectors required for the project include the following:
 - 1. 600V building conductors
 - 2. 600V building conductor connectors
 - 3. 600V 2-hour fire rated power cable
- C. Application: The applications for conductors and connectors required on the project are as follows:
 - 1. Power distribution circuitry
 - 2. Lighting branch circuitry
 - 3. Appliance, receptacle, and equipment branch circuitry
 - 4. Motor branch circuitry
 - 5. Control wiring
 - 6. Line voltage
- D. Refer to other specific specification sections for voice, video, data, alarm and instrumentation cables.

1.2 QUALITY ASSURANCE

- A. UL Label: Conductors and connectors shall be UL labeled.

1.3 REFERENCES

- A. Refer to other specific specification sections regarding specialized wiring and connections.

PART 2 – PRODUCTS – Provide products manufactured in the USA

2.1 CONDUCTORS AND CONNECTORS

- A. General: Except as indicated, provide conductors and connectors of manufacturer's standard materials, as indicated by published product information, designed and constructed as instructed by the manufacturer, and as required for the installation.
- B. Conductors: Provide factory-fabricated conductors of the size, rating, material, and type as indicated for each use. Conductors shall be soft or annealed copper wires meeting, before stranding, the requirements of ASTM B 3, Standard Specification for Soft or Annealed Copper Wire for Electrical Purposes, latest edition.
 - 1. Conductors for control wiring sized #14 AWG through #10 AWG shall be stranded.
 - 2. Conductors for power and lighting shall be stranded. Stranding shall be Class B meeting the requirements of ASTM B 8, Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium Hard, or Soft.
- C. Insulation for standard building conductors: Insulation shall meet or exceed the

requirements of UL 83, Standard for Thermoplastic Insulated Wires.

1. All wiring inside lighting fixtures shall be temperature rated per NEC.
2. Insulation for copper conductors shall be UL Type THHN/THWN, 90 degrees C.

D. Insulation for 2-hour fire rated power cables: Insulation shall meet or exceed the requirements of UL 2196 Fire Test for Electrical Circuit Protection Systems, and UL 44, Standards for Fire Resistive Cable. Conductor ampacity shall be based on 75C. Combination UL Type insulation types are permissible where the required UL Type is part of the combination UL listing.

1. Conductors installed underground: Insulation for underground fire rated conductors shall be wet location, UL Type RHW 75 degrees C, or UL RHW-2 90 degrees C.
2. Conductors installed above ground: Insulation for above ground fire rated conductors shall be UL Type RHH 90C or RHW 75C or UL RHW-2 90C.
3. Electrical Circuit Protective Systems (FHIT) – System 27 of the UL Fire Resistance Directory

E. Cable Lubricant: Fire resistant, nonflammable, water-based type for standard building conductors. Provide cable lubricants for fire rated cables as recommended by the cable manufacturer.

2.2 COLOR CODES FOR CONDUCTORS FOR BRANCH CIRCUITS AND FEEDERS

A. Color coding for conductors as required by NEC 210.5. Color coding for phase and voltage shall be as required by local codes and local standards. Where such standards do not exist, color coding shall be as follows:

| Color Code Table | USE CONTINUOUS COLOR-CODED INSULATION THROUGHOUT | | | | | |
|------------------|--|--------|--------|-------|-------|---------------------|
| System/Phase | A | B | C | N | G | IG |
| 120/208 3 Ph | Black | Red | Blue | White | Green | Green/Yellow Stripe |
| 120/240 3 Ph | Black | Orange | Blue | White | Green | Green/Yellow Stripe |
| 120/240 1 Ph | Black | N/A | Blue | | | |
| 277/480 | Brown | Purple | Yellow | Gray | Green | Green/Yellow Stripe |

Notes to Color Code Table:

1. 120/208, 120/240, and 277/480 Volt Systems shall be routed in separate raceways.
2. Switched legs of phase conductors for lighting and appliance branch circuits shall be of the same color as described above throughout the entire circuit.
3. Conductors shall be the same color from breaker to device or outlet.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. General: Install electrical conductors and connectors as shown, in accordance with the manufacturer's written instructions, the requirements of NEC, the NECA Standard of Installation, and industry practices.
- B. Coordination: Coordinate conductor installation work with electrical raceway and

equipment installation work, as necessary for interface.

C. Conductors:

1. Provide a grounded (neutral) conductor for each branch circuit. Do not share grounded (neutral) conductors.
2. No more than six phase conductors shall be installed in a single raceway. Any combination of phase conductors and grounded (neutral) conductors in any raceway shall not exceed nine.
3. When any combination of four or more phase and grounded (neutral) conductors are installed in a raceway, the minimum size for all conductors including equipment ground conductor shall be #10 AWG, and they shall be de-rated accordingly.
4. When more than four (4) conductors are size #10 AWG, they shall be installed in a one-inch conduit.
5. Pull conductors together when more than one is being installed in a raceway. Whenever possible, pull conductors into their respective conduits by hand. Use pulling lubricant when necessary.
6. Before any conductor is pulled into any conduit, thoroughly swab the conduit to remove foreign material and to permit the wire to be pulled into a clean, dry conduit.
7. Run feeders their entire length in continuous section without joints or splices.
8. No wire smaller than #12 AWG shall be permitted for any lighting or power circuit. No wire smaller than #14 AWG shall be used for any control circuit, unless shown otherwise.
9. Provide the same size wire from the panelboard to last outlet on circuit. For 20 amp branch circuits operating at 150V or less, provide #10 AWG wire when the first outlet is over 75-feet from the panelboard. For branch circuits operating at 150 to 600 volts, provide #10 AWG wire when the first outlet is over 150-feet from the panelboard.
10. Branch circuit voltage drop shall not exceed 3% of rated voltage.
 - a. Total voltage drop from the point of service to the last outlet or utilization equipment of the same voltage shall not exceed five-percent of rated voltage.
 - b. Total voltage drop from the point of service to transformers with adjustable taps, buck-boost transformers, uninterruptable power supplies (UPS), or voltage regulators shall not exceed five-percent of rated voltage.
 - c. Total voltage drop from a separately derived system, transformer with adjustable taps, buck-boost transformer, uninterruptable power supply (UPS), or voltage regulator to the last outlet or utilization equipment of the same voltage shall not exceed five-percent of rated voltage.
 - d. Total voltage drop from the point of service to distribution equipment of the same voltage shall not exceed two-percent of rated voltage.
 - e. Branch circuit voltage drop from distribution equipment to the last outlet or utilization equipment shall not exceed three-percent of rated voltage.
 - f. Provide the same size branch circuit conductors to last outlet on circuit unless specifically noted or indicated otherwise on the drawings. For 20 amp branch circuits operating at 150-Volts or less, provide #10 AWG wire when the first outlet is over 75-feet from the panelboard. For branch circuits operating above 150-Volts to 600-Volts, provide #10 AWG wire when the first outlet is over 150-feet from the panelboard.
11. No tap or splice shall be made in any conductor except in outlet boxes, pull boxes, junction boxes, splice boxes, or other accessible locations. Make taps and splices using an approved compression connector. Insulate taps and splices equal to the adjoining conductor. Make splices or taps only on conductors that are a component part of a single circuit, protected by approved methods. Taps or

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- splices in feed through branch circuits for connection to light switches or receptacles shall be made by pigtail connection to the device.
12. Support conductors in vertical raceways, as required by the NEC.
 13. Do not permit conductors entering or leaving a junction or pull box to deflect to create pressure on the conductor insulation.
 14. Make joints in branch circuits only where circuits divide. These shall consist of one through circuit to which the branch from the circuit shall be spliced.
 15. Make connections in conductors up to a maximum of one #6 AWG wire with two #8 AWG wires using twist-on pressure connectors of required size.
 16. Make connections in conductors or combinations of conductors larger than specified using cable fittings of type and size required for specific duty.
 17. After a splice is made, insulate entire assembly with UL-approved insulating tape to a value equivalent to the adjacent insulation.
 18. Make splices and connections in control circuit conductors using UL-approved solderless crimp connectors.
 19. All conduits shall be installed with an insulated grounding conductor per NEC 250.122. Where green conductor insulation is not available, the ground conductor shall be identified with green phasing tape at all accessible locations.
 20. Neatly train and lace wiring inside boxes, equipment and panelboards. Provide tie-straps around conductors with their shared neutral conductor where there are more than two neutral conductors in a conduit.
 21. Clean conductor surfaces before installing lugs and connectors.
 22. Make splices, taps and terminations to carry full ampacity of conductors with no perceptible temperature rise.
 23. Provide stranded conductors connected with pressure type connectors / compression fittings and terminal lugs UL listed for the type of conductor used (AL-CU) and correctly sized to the diameter of the bare conductors.
 24. Run mains and feeders their entire length in continuous pieces without splices or joints.
 25. Color code conductors.
 26. Do not install a pull string in conduits containing conductors.
 27. Conductors shall be the same color from load side of overcurrent protection device to outlet or utilization equipment.
 28. Spare conductors shall not be installed in any conduit, gutter, raceway, panel or enclosure unless noted otherwise.

D. Two-hour fire rated cable:

1. Two-hour fire rated power cable shall be installed per manufacturer's installation instructions in compliance with UL Fire Resistance Directory, Electrical Circuit Protective Systems (FHIT), and System 27.
2. Two-hour fire rated power cable shall be installed in rigid steel EMT or rigid steel galvanized conduit (RGC) with steel fittings. Provide fire rated sealant to the end of the raceway to prevent gases from migrating from the fire rated cable into the equipment.
3. Provide two-hour rated cable where conduit or cables enters or passes through the building envelope at areas or rooms that are not two-hour rated equipment rooms for the following:
 - a. Fire Pump feeders.
 - b. Emergency Feeders (Life Safety) as defined by NFPA Article 700.
 - c. Legally required level one standby systems as defined by NFPA 110 and NFPA Article 701. These systems include but are not limited to those used to aid firefighting and rescue operations, smoke removal systems, and elevators designated for ADA and/or fire rescue operations.
4. Alternate two hour rated feeder conductor sizes may be substituted for the required conductor ampacity, voltage drop, or equipment lug terminations based on two-hour fire rated conductor standard size availability or provided equipment

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manufacturer's cable terminations. The substituted conductor ampacity shall meet or exceed the specified cable ampacity and exceed the required equipment minimum circuit ampacity. Provide substitutions and the required conduit sets and sizes as required for the substitutions at no additional cost to the Owner.

- E. Identification: Label each phase conductor in each junction box with corresponding circuit number, using self-adhesive wire markers.
- F. Splices and Joints:
 - 1. In accordance with UL 486A, C, D, E, and NEC.
 - 2. Aboveground Circuits (No. 10 AWG and smaller):
 - a. Connectors: Solderless, screw-on, reusable pressure cable type, rated 600 V, 220° F, with integral insulation, approved for copper and aluminum conductors. Push-in type connectors are prohibited.
 - b. The integral insulator shall have a skirt to completely cover the stripped wires.
 - c. The number, size, and combination of conductors, as listed on the manufacturers' packaging, shall be strictly followed.
 - 3. Motor connections:
 - a. All AHU motors connections shall be split bolt connectors.
 - b. All non-AHU motors 10 HP and larger shall be split bolt connectors.
 - c. All non-AHU motors less than 10 HP shall be split bolt connectors or as recommended by the manufacturer.
- G. Aboveground Circuits (No. 8 AWG and larger):
 - 1. Connectors shall be indent, hex screw, or bolt clamp type of high conductivity and corrosion resistant material, listed for use with copper and aluminum conductors.
 - 2. Provide field-installed compression connectors for cable sizes 250 kcmil and larger with not less than two clamping elements or compression indents per wire.
 - 3. Insulate splices and joints with materials approved for the particular use, location, voltage, and temperature. Splice and joint insulation level shall be not less than the insulation level of the conductors being joined.
 - 4. Plastic electrical insulating tape: Per ASTM D2304, flame-retardant, cold and weather resistant.
- H. Underground Branch Circuits and Feeders:
 - 1. Submersible connectors in accordance with UL 486D, rated 600 V, 190°F, with integral insulation.

3.2 TESTING

- A. Pre-Energization Check: Before energizing, check cable and conductors for circuit continuity and short circuits. Correct malfunctions.
- B. Service Entrance and Feeder Insulation Resistance Test: Each main service entrance conductor and each feeder conductor shall have its insulation resistance tested after the installation is complete except for connection at its source and point of termination. Testing shall be performed by qualified technicians who have been trained in testing procedures and in the use of all test equipment.
 - 1. Make tests using a Biddle Megger or equivalent test instrument at a voltage of not less than 1000 VDC; measure resistance from conductor to conductor, conductor to neutral (if present) and from conductor to ground. Insulation resistance shall not be less than the following:

| Wire Size (AWG) | Insulation Resistance (Ohms) |
|-----------------|------------------------------|
|-----------------|------------------------------|

| | |
|------------------|-------|
| #8 | 250 K |
| #6 through #2 | 100 K |
| #1 through #4/0 | 50 K |
| Larger than #4/0 | 25 K |

2. Conductors that do not meet or exceed the insulation resistance values listed above shall be removed, replaced, and retested.

- C. Submittals: Contractor shall furnish instruments and personnel required for tests. Submit 4 copies of certified test results to Architect for review. Test reports shall include conductor tested, date and time of test, relative humidity, temperature, and weather conditions.

- D. Voltage and Current Values: The voltage and current in each conductor shall be measured and recorded after connections have been made and the conductor is under load.

SAMPLE DC HIGH VOLTAGE CABLE TEST REPORT
 (Specification Paragraph 3.2, C)

Date _____

Contract and Work Location: _____
 Contract (Project) No.: _____
 Circuit Identification: _____
 (Dwg., Title, Number and Ckt. Number)

Test Equipment: _____
 (Make, Model, Serial No., Etc.)
 Applied Test Voltage _____
 Normal Oper. Voltage _____
 Cable Installation: New _____ Used _____
 (Date) (No. Years)
 Cable Size _____ AWG
 Cable Length _____ Ft.
 Cable Material _____ Cu _____ Al
 Temperature _____ Humidity _____

TEST DATA - RESISTANCE IN KILO OHMS

| CONDUCTOR PER PHASE | A-N | B-N | C-N | A-G | B-G | C-G | A-B | B-C | A-C |
|---------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| | | | | | | | | | |

END OF SECTION

SECTION 26 05 26 - ELECTRICAL GROUNDING

PART 1 – GENERAL

1.1 WORK INCLUDED

- A. Grounding shall conform to the requirements of:
 - 1. National Electrical Code.
 - 2. Governing local codes.
 - 3. All Local Utility Companies
- B. Ground effectively and permanently.
 - 1. Neutral conductor at the main service disconnect and other separately derived systems.
 - 2. All conduit systems.
 - 3. All electrical equipment and related current carrying supports or structures.
 - 4. All metal piping systems.
 - 5. All building structural metal frames.
 - 6. All telephone/voice/video/CATV/data utilities

1.2 REFERENCE STANDARDS

- A. ANSI/IEEE Standard 142 - "Recommended Practice for Grounding of Industrial and Commercial Power Systems."
- B. ANSI/UL 467 - "Safety Standard for Grounding and Bonding Equipment."
- C. Article 250 of the NEC (NFPA 70) for grounding.
- D. NECA – Standard of Installation
- E. NETA ATS – Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems
- F. EIA / TIA 607

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Copperweld
- B. nVent ERICO
- C. Burndy
- D. O. Z Gedney
- E. Eaton

2.2 GROUNDING ELECTRODES

- A. Driven Rod Electrode
 - 1. 3/4" x 10'-0" copper clad grounding electrode.
 - 2. UL listed.

- 3. Approved thermal fusion connector methods (exothermic).
 - B. Metal frame of building or enclosure.
 - C. Foundation concrete encased rebar.
- 2.3 DATA / VOICE COMMUNICATIONS CLOSET GROUND BAR
- A. MDF closets/head end rooms: Erico Cadweld #B544A028 ground bar with 7/16-inch holes.
 - B. IDF closets, Erico Cadweld #B542A004 ground bar with 7/16-inch holes.
 - C. Heavy-duty, two bolt type, copper alloy or bronze for grounding and bonding applications, in configurations required for particular installation.
- 2.4 EXOTHERMIC CONNECTIONS
- A. Exothermic type for underground and structural steel; Cadweld
 - B. Exothermic materials, accessories, and tools for preparing and making permanent field connections between grounding system components.
- 2.5 WIRE
- A. Stranded, copper cable
 - B. Foundation Electrodes: 4/0 AWG
 - C. Grounding Electrode Conductor: Size to meet NFPA 70 requirements

PART 3 – EXECUTION

3.1 GROUNDING AND BONDING

- A. In the service equipment, provide a separate (dedicated) ground bus.
 - 1. Bond the ground bus with copper bus bar or cable, of equal or greater current carrying capacity of the service grounding conductor, to the neutral bar.
 - 2. Resistance of neutral to ground shall not exceed 10 Ohms.
 - 3. Connect the electric service grounding electrode conductors to the incoming metal water pipe system (when available, using a suitable ground clamp) and to a supplemental electrode such as a ground rod or ground ring.
 - 4. Provide grounding and bonding at the power company's metering equipment.
 - 5. Provide access and cover for access to the ground grid and removable connections for testing the system.
- B. Connect the grounding electrode conductor between the ground bus and the grounding electrode system.
 - 1. In rigid PVC conduit.
 - 2. Provide thermo fusion connection for each rod ground electrode.
 - a. All rod electrodes shall be located outside the building in non-paved areas where available. Access cover top shall be flush with finish grade or floor.
 - b. Install rod electrodes as required. Install additional rod electrodes as required to achieve specified resistance to ground.

- c. The minimum distance between driven ground rod electrodes shall be 10'.
 3. The total ground resistance shall not exceed 10 Ohms for service entrance grounds and 25 Ohms for equipment grounds.
 - a. Where this condition cannot be obtained with one electrode, install a longer electrode, deep-driven sectional electrodes, or additional grounding electrodes until the required ground resistance is obtained.
- C. Provide an insulated equipment grounding conductor inside all conduits, raceways, surface raceways, gutters and wireways. The ground wire shall be bonded to each box to suitable lug, bus, or bushing. All bonding jumpers shall be routed inside conduit or raceway.
- D. Provide an insulated isolated equipment grounding conductor in addition to the insulated equipment grounding conductor for all isolated grounding feeders, branch circuits, outlets and isolated grounding receptacles.
- E. Provide all conduit terminating in switchgear, transformers, switchboards, panelboards and voice/data outlets with grounding bushings, where required, and ground wire extended to ground bus in equipment. Install grounding bushings where reducing washers are used and concentric and eccentric knock-outs are used.
- F. Main bus and building grounding electrode conductor installation shall be witnessed by the Architect / Engineer.
- G. Provide bonding to meet Regulatory Requirements.
- H. Interface with lightning protection system when lightning protection system is specified.
- I. Locate and install anchors, fasteners, and supports in accordance with NECA "Standard of Installation".
- J. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.
- K. Do not use spring steel clips and clamps.
- L. Do not use powder-actuated anchors.
- M. Do not drill or cut structural members.
- N. Do not use compression or mechanical connectors underground.
- O. Do not use sheetmetal or self-drilling screws for bonding connections. Provide listed or approved connectors.
- P. Provide grounding access well for each driven ground electrode, not located in manholes or pull boxes.
 1. Access well top shall be flush with finish paved surfaces.
 2. Ground access wells located in non-paved areas shall be set two-inches above surrounding finished grade. Provide 12-inch wide by 8-inch deep reinforced concrete crown around neck or opening and sloped down away from pull box opening.
 3. Provide thermal fusion (exothermic) connectors approved for direct burial.

3.2 METAL FRAME OF BUILDING OR STRUCTURE

- A. Effectively ground the building steel or structure per NEC 250-52 (2).

3.3 UFER GROUND

- A. Provide a UFER ground at bottom of building slab per NEC 250.52 (3), bond to building steel.

3.4 MISCELLANEOUS REQUIREMENTS

- A. Continuity of the equipment grounding system shall be maintained throughout the project. Equipment grounding jumpers shall be installed across conduit expansion fittings, liquid-tight flexible metal and flexible metal conduit, and other non-electrically continuous raceway fittings.
- B. Equipment grounding conductors and grounding electrode conductor shall be stranded copper conductors and run in a suitable raceway. Grounding conductors and grounding electrode conductor shall be continuous, without joints or splices over their entire length, except as allowed by NFPA 70/NEC.
- C. For separately derived alternating current system grounds, bond the case and neutral of each transformer secondary winding directly to the nearest available effectively grounded structural metal member as required in NEC 250.
- D. Exterior Electrical Equipment Racks:
 - 1. Provide driven ground electrode.
- E. Technology/Data/Voice Communications, CATV, CCTV, and MATV Equipment Grounding: Provide grounding electrode conductor from the communications service equipment to the building grounding system as required. Grounding shall conform to ANSI/TIA/EIA 607(A) – Commercial Building Grounding and Bonding Requirements for Telecommunications, National Electrical Code®, ANSI/NECA/BICSI-568 and manufacturer's grounding requirements as minimum. Bonding shall be of low impedance to assure electrical continuity between bonded elements.
 - 1. MDF Closets Telecommunications Main Ground Bar (TMGB): Provide Erico #EGBA14424MM ground bar, wall mounted to the telecommunications plywood backboard. Provide one #3 AWG insulated ground conductor from ground bar to building steel. Provide #2/0 AWG insulated ground conductor to the building electrical service ground at the nearest electrical switchboard or panelboard.
 - 2. IDF Closets Telecommunications Ground Bar (TGB): Provide Erico #EGBA14410FF ground bar mounted to the telecommunications plywood backboard. Provide one #6 AWG insulated ground conductor from ground bar to building steel and to ground bus of nearest electrical panelboard or switchboard.
 - 3. Provide #2/0 AWG insulated ground conductor between each TMGB and all TGBs.
 - 4. Provide #2/0 AWG insulated ground conductor from TMGB to electrical service ground bus at main electrical service switch.
 - 5. Bond each equipment rack, cabinets, frames, together and with #6 AWG insulated ground conductor to the local TMGB / TGB. Bond and ground equipment racks, housings, messenger cables, raceways, and rack-mounted conduit.
 - 6. Route TMGB – TGB ground conductor using the shortest, straightest, route practical with long radius curves.

7. All conduits terminating to cable trays, wireways, and racks shall be mechanically fastened. When connected to a cable tray or rack, it must be connected with ground bushings, wire bonded to the tray or rack, and grounded to the main building grounding system or IDF room grounding bar using #6 AWG copper.
- F. Ground lighting fixture bodies to the conduit grounding system.
- G. Bond receptacle ground to the box and conduit ground system, except where and insulated/isolated grounding receptacle or outlet is specified.
- H. Ground connections to building steel, grounding electrodes and all underground connections shall be by thermal fusion (exothermic).
- I. Provide OZ Type "BJ" bonding jumper at all expansion joints, points of electrical discontinuity or connections in conduit where firm mechanical bond is not possible, such as flexible connections, insulating couplings, etc.
- J. Ground each lighting and power panelboard by connecting the grounding conductors to the grounding stud.
- K. Ground each secondary dry-type transformer to the ground bus of the primary side panelboard. Provide a bonding jumper between the ground stud and the neutral. Ground transformer ground stud to ground ring if a ground ring is installed or the nearest structural steel member.
- L. Bond every item of equipment served by the electrical system to the building equipment ground system. This includes, but is not limited to, switchboards, panelboards, disconnect switches, receptacles, cable trays, controls, fans, air handling units, pumps and flexible duct connections.
- M. Ground each light pole, power distribution poles, and metal conduit stub-ups at each light pole base.
- N. Ground all metal conduit including metal conduit used for bends and penetrations through concrete.
- O. Bond hot water and cold water piping together at each domestic water heater.

3.5 MANHOLE AND/OR PULL BOX GROUNDING

- A. Provide a driven ground rod and ground bond ring in each power and telephone manhole or pull box. Bond cable racks and medium voltage cable shields at splices and terminations, ductbank conduit ground bushings and all other metal components in manholes or pull box to the ground ring.

3.6 COORDINATION

- A. General: Coordinate installation of grounding connections for equipment with equipment installation work.

3.7 TESTING

- A. Ground Resistance Test: Perform a ground resistance test for comparison to future inspection and testing data by the Owner. Test shall be performed using a Bidle

Megger Earth Tester or equivalent test instrument. The test shall not be performed within 48 hours after the last rainfall.

1. Inspect and test in accordance with NETA ATS except Section 4
 2. Grounding and Bonding: Perform inspections and tests listed in NETA ATS, Section 7.13
- B. True Root Mean Square (RMS) AC measurements: The True RMS AC Measure test should be performed for all bonding conductors. The recommended maximum AC current value on any bonding conductor should be less than 1 ampere (A). The recommended maximum DC current value should be less than 500 milliamperes (mA). If abnormally high AC current levels are present on any bonding conductor, a dangerous faulty wiring condition likely exists within the room.
- C. Two-Point Bonding Measurements: The Two-point Bonding test should be performed for all bonding conductors. This test should be performed using an earth grounding resistance tester configured for a continuity test. The test is performed by connecting the meter leads between the nearest available grounding electrode (e.g., structural steel) and the TMGB or TGB. The recommended maximum value for the bonding resistance between these two points is 0.1 Ohms (100 milliohms).
- D. Submittals: Furnish instruments and personnel required for tests. Personnel shall be trained in all aspects of testing grounding systems and shall be formally trained on using all test equipment required. Submit 2 copies of certified test results for Owner's record and submit 4 copies of certified test results to Architect / Engineer for review. Test reports shall include date and time of tests, relative humidity, temperature, and weather conditions.

END OF SECTION

**SECTION 26 05 27 - EXPANSION OF EXISTING ELECTRICAL
GROUNDING SYSTEM**

PART 1 – GENERAL

1.1 WORK INCLUDED

- A. Grounding shall conform to the requirements of:
 - 1. National Electrical Code
 - 2. Governing local codes
 - 3. Local Utility Company

- B. Ground effectively and permanently.
 - 1. Verify existing neutral conductor bonding at the main service disconnect and at other new/relocated or reused separately derived systems.
 - 2. All new/relocated conduit or cable tray systems and busway
 - 3. All new/relocated electrical equipment and related current carrying supports or structures
 - 4. All new / relocated metal piping systems
 - 5. All new building structural metal frames

1.2 REFERENCE STANDARDS

- A. ANSI/IEEE Standard 142 - "Recommended Practice for Grounding of Industrial and Commercial Power Systems."
- B. ANSI/UL 467 - "Safety Standard for Grounding and Bonding Equipment."
- C. Article 250 of the NEC (NFPA 70) for grounding.
- D. NECA – Standard of Installation
- E. NETA ATS – Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems
- F. EIA / TIA 607

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Copperweld
- B. nVent ERICO
- C. Burndy
- D. O.Z. Gedney
- E. Eaton

2.2 GROUNDING ELECTRODES

- A. Driven Rod Electrode
 - 1. 3/4" x 10'-0" copper clad grounding electrode, UL listed

2. UL listed grounding electrode connector
 3. Approved thermal fusion methods (exothermic)
- B. Metal Frame of Building
- C. Existing grounding electrode system

2.3 DRIVEN ELECTRODE ACCESS BOX AND COVER

- A. Hubbell Tier 22 FRP 20-inch round bolt down cover with "GROUND" embossed on top.

2.4 MATERIALS AND COMPONENTS

- A. Reference other sections of this specifications for materials specified there.
- B. Heavy-duty, copper, two bolt type, copper alloy or bronze compression lugs for grounding and bonding applications, in configurations required for particular installation.

PART 3 – EXECUTION

3.1 SYSTEMS 600 VOLTS OR LESS

- A. In the existing service equipment, field verify existing condition of ground bus.
1. Field verify existing bond of the ground bus to the existing service grounding conductor, to the neutral bar.
 2. Tighten existing ground lugs and connections.
- B. Connect the grounding electrode conductor between the ground bus and the grounding electrode system.
1. In rigid PVC conduit.
 2. Provide thermo fusion connection for each rod ground electrode.
 - a. All rod electrodes shall be located outside the building in non-paved areas where available. Access cover top shall be flush with finish grade or floor.
 - b. Install rod electrodes as indicated. Install additional rod electrodes as required to achieve specified resistance to ground.
 - c. The minimum distance between driven ground rod electrodes shall be 10'.
 3. The total ground resistance shall not exceed 10 Ohms for service entrance grounds and for equipment grounds.
 - a. Where this condition cannot be obtained with one electrode, install a longer electrode, deep-driven sectional electrodes, or additional grounding electrodes until the required ground resistance is obtained.
 - b. Refer to drawings for project specific ground resistance requirements.
- C. Field verify the grounding electrode conductor between the ground bus and the grounding electrode systems are in compliance with the NEC.
- D. Provide an insulated grounding conductor inside all new conduits, raceways, surface raceways and cables used for power distribution. The ground wire shall be bonded to each box. All bonding jumpers shall be routed inside conduit or raceway
- E. Provide an insulated, isolated equipment grounding conductor in addition to the insulated equipment grounding conductor for all isolated grounding feeders, branch circuits, outlets and receptacles.

- F. Provide all new/relocated conduits terminating in switchgear, transformers, switchboards, and panelboards with grounding bushings, where required and ground wire extended to ground bus in equipment.
- G. Where modifications to the main service disconnect are required, main bus and building grounding electrode conductor installation shall be witnessed by the Architect / Engineer.
- H. Interface with lightning protection system when lightning protection system is specified.
- I. Locate and install anchors, fasteners, and supports in accordance with NECA "Standard of Installation".
- J. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.
- K. Do not use spring steel clips and clamps.
- L. Do not use powder-actuated anchors.
- M. Do not drill or cut structural members.
- N. Do not use compression or mechanical connectors underground.

3.2 SYSTEMS OVER 600 VOLTS

- A. Provide insulated grounding bushings at each new/relocated conduit termination. The grounding system shall be made continuous with bare copper jumpers.
 - 1. Connect the copper grounding jumpers to the ground bus in the equipment.
- B. Install a grounding conductor in each conduit.
 - 1. 600 V code gauge Type XHHW.
 - 2. Green insulation.
- C. Connect the grounding conductor to:
 - 1. Each new/relocated/reused splice or pull box enclosure.
 - 2. Each new/relocated/reused transformer enclosure.
 - 3. All new/relocated/reused primary switchgear enclosures.

3.3 MISCELLANEOUS REQUIREMENTS

- A. Continuity of the building equipment grounding system shall be maintained throughout the project. Grounding jumpers shall be inside conduit, fittings and boxes and shall be installed across conduit expansion fittings, liquid-tight flexible metal and flexible metal conduit, light fixture pigtails in excess of 6', and other non-electrically continuous raceway fittings.
- B. Grounding conductors and grounding electrode conductor shall be stranded copper conductors and run in a suitable PVC raceway. Grounding conductors and grounding electrode conductor shall be continuous, without joints or splices over their entire length, except as allowed by NFPA 70/NEC.
- C. For separately derived alternating current system grounds, bond the case and neutral of each transformer secondary winding directly to the nearest available effectively grounded structural metal member as required in NEC 250.
- D. Technology/Data/Voice Communications, CATV, CCTV, and MATV Equipment

Grounding: Provide grounding electrode conductor from the communications service equipment to the building grounding system as required. Provide #6 ground conductor from telephone/voice/CATV/data company demarcation point to building electrical service entrance ground electrode connection and as required by all local utility companies.

1. New MDF Closets Telecommunications Main Ground Bar (TMGB): Provide Erico Cadweld #B544A028 ground bar with 7/16-inch holes, wall mounted to the telecommunications plywood backboard. Provide one #3 AWG insulated ground conductor from ground bar to building steel. Provide #2/0 AWG insulated ground conductor to the building electrical service ground at the main electrical service disconnect.
 2. New IDF Closets Telecommunications Ground Bar (TGB): Provide Erico Cadweld #B542A004 ground bar with 7/16-inch holes, mounted to the telecommunications plywood backboard. Provide one #6 AWG insulated ground conductor from ground bar to building steel.
 3. Provide #2/0 AWG insulated ground conductor between each TMGB and all TGBs.
 4. Provide #2/0 AWG insulated ground conductor from TMGB to electrical service ground bus at main electrical service switch.
 5. Bond each equipment rack with #6 AWG insulated ground conductor to the TMGB / TGB.
 6. Route TMGB – TGB ground conductor using the shortest route practical with long radius curves.
- E. Ground new and removed/replaced lighting fixture bodies to the conduit grounding system.
- F. Receptacles: Provide a ground wire bonded to the conduit ground system, except where and insulated isolated grounding receptacle is specified.
- G. Motor Frames: Ground the frame of each motor with a properly sized separate ground wire around flexible conduit.
- H. Provide grounding access well for each driven ground electrode, not located in manholes or pull boxes.
1. Access well top shall be flush with finish paved surfaces.
 2. Ground access wells located in non-paved areas shall be set two-inches above surrounding finished grade. Provide 12-inch wide by 8-inch deep reinforced concrete crown around neck or opening and sloped down away from pull box opening.
 3. Provide thermal fusion (exothermic) connectors approved for direct burial.
- I. Ground all light poles and all exterior metal structures supporting conduit, switchgear, or light fixtures.
- J. Exterior Electrical Equipment Racks:
1. Provide driven ground electrode for racks mounted remote from building structure.
 2. Where mounted on roof, ground to be building structural steel.
- K. Ground connections to building steel, grounding electrodes and all underground connections shall be by thermal fusion (exothermic).
- L. Transformers: Provide driven ground electrode and building steel electrode at each transformer.

- M. Bond hot water and cold water piping together at each domestic water heater.

3.4 COORDINATION

- A. General: Coordinate installation of grounding connections for equipment with equipment installation work.

3.5 TESTING

- A. Ground Resistance Test: Perform a ground resistance test for comparison to future inspection and testing data by the Owner. Test shall be performed using a Biddle Megger Earth Tester or equivalent test instrument. The test shall not be performed within 48 hours after the last rainfall.
 - 1. Inspect and test in accordance with NETA ATS except Section 4
 - 2. Grounding and Bonding: Perform inspections and tests listed in NETA ATS, Section 7.13
- B. The Root Mean Square (RMS) AC measurements: The True RMS AC Measure test should be performed for all bonding conductors. The recommended maximum AC current value on any bonding conductor should be less than 1 ampere (A). The recommended maximum DC current value should be less than 500 milliamperes (mA). If abnormally high AC current levels are present on any bonding conductor, a dangerous faulty wiring condition likely exists within the room.
- C. Two-Point Bonding Measurements: The two-Point Bonding test shall be performed for all bonding conductors. This test should be performed using an earth grounding resistance tester configured for a continuity test. The test is performed by connecting the meter leads between the nearest available grounding electrode (e.g., structural steel) and the TMGB or TGB. The recommended maximum value for the bonding resistance between these two points is 0.1 ohms (100 milliohms).
- D. Submittals: Furnish instruments and personnel required for tests. Personnel shall be trained in all aspects of testing grounding systems and shall be formally trained on using all test equipment required. Submit 2 copies of certified test results for Owner's record and submit 4 copies of certified test results to Architect / Engineer for review. Test reports shall include date and time of tests, relative humidity, temperature, and weather conditions.

END OF SECTION

SECTION 26 05 32 - SURFACE SMALL STEEL RACEWAY

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Furnish and install a complete system of electrical surface steel raceways, boxes, and fittings. Installation surface raceway shall only be where indicated on the drawings or where installation of concealed raceways in existing walls is physically impossible or impractical and as verified and approved by the Architect/Owner.
- B. This specification covers a surface small steel metal raceway system used for branch circuit wiring or low-voltage wiring. The steel raceway system shall consist of a raceway, appropriate fittings, wiring device boxes, and device brackets to complete the installation per the electrical, low voltage system drawings. Where raceways are specified or required to mount wiring devices directly in the raceway cover, provide aluminum dual channel Wiremold AL5200 series, refer to appropriate specification section for more information.

1.2 CLASSIFICATION AND USE

- A. Steel surface metal raceway is to be utilized in dry interior locations only as covered in Article 386 of the National Electrical Code, as adopted by the National Fire Protection Association, and as approved by the American National Standards Institute.

1.3 SUBMITTALS

- A. Shop Drawings: Submit drawings for review showing the complete layout of all products that make up the complete system for each installation prior to installations with device type (power and data), locations, and circuits identified.
- B. Mark up a copy of the specifications for the product. Indicate in the margin of each paragraph the following: "Comply," "Do Not Comply", or "Not Applicable". Explain all "Do Not Comply" statements.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. The steel surface metal raceway system specified herein for branch circuit and other low-voltage wiring shall be of the depth and width as required for wiring/cabing and number of conductors /cables as manufactured by Legrand Wiremold Company.

2.2 MATERIALS

- A. General:
 - 1. System: Provide surface raceway systems for branch circuits and low-voltage wiring. Surface raceway system components necessary for a complete installation shall consist of the raceway bases, covers, boxes, fittings, and wiring device mounting plates.
 - 2. Configuration: Raceways shall be a two-piece design with base and snap-on cover.
 - 3. Fittings:
 - a. Fittings shall include flat, internal, and external elbows, couplings for joining raceway sections, wire clips, blank end fittings, and device boxes,

- mounting brackets and plates as applicable.
 - b. Provide full capacity corner elbows and tee fittings to maintain a controlled 2 inches cable bend radius, meeting the specification for Fiber Optic and UTP cabling and exceeding the TIA/EIA-569-A requirements for communications pathways.
 - 4. Device Brackets and Plates: Provide in sizes to match the raceway width and with mounting holes located to ensure proper mounting. Plate shall overlap cover to conceal seam.
 - 5. Communications Devices and accessories shall accommodate a complete line of connectivity outlets and modular inserts for UTP, STP, fiber optic, coaxial, audio, video, and other cabling types with matching faceplates and bezels to facilitate mounting.
 - 6. Finish: Manufacturer's standard ivory or custom color as specified.
- B. Surface Metallic Raceways:
- 1. Wiremold 700 Series: 3/4 inches wide by 7/8 inch deep; 0.26-square inch capacity, downward facing devices, bend radius control fittings.
 - 2. Wiremold 2400 Series: 1-7/8 inches wide by 7/8 inch deep; 1.39-square inch capacity, downward facing devices, bend radius control fittings.
 - 3. Wiremold 2400D Series: Dual channel. 1-7/8 inches wide by 7/8 inch deep; 0.374 and 0.865-square inch capacity, downward facing devices, bend radius control fittings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Provide surface steel raceway only where indicated on the drawings, or only at renovation construction areas where routing conduits or steel metal clad cable concealed in existing masonry or concrete block walls is impossible or impractical. Contractor shall field coordinate and/or demonstrate to the Architect and/or Owner that installing concealed raceway is impossible or impractical or provide a minor selective demolition and wall repair option to be approved by the Architect/Owner. Otherwise, a concealed raceway shall be provided as specified in Section 26 05 33 Conduit Systems. Where raceways are specified or required for wiring device installation directly in the raceway cover, provide aluminum dual channel Wiremold AL5200 series, refer to the appropriate specification section for more information.
- B. Prior to and during installation, refer to system layout drawing containing all elements of the system; comply with detailed manufacturer's installation instruction sheets, which accompany system components, as well as system instruction sheets, whichever is applicable. Use manufacturer's approved cutting tools for cutting raceways.
- C. Mechanical Security: All raceway systems shall be mechanically continuous and connected to all electrical outlets, boxes, cabinets, in accordance with manufacturer's installation sheets.
- D. Electrical Security: All metal raceways shall be electrically continuous and bonded in accordance with the National Electric Code for proper grounding.
- E. Work shall include fastening all raceways and appropriate fittings and device plates to install a complete steel surface raceway system as indicated on the electrical, communication, safety and security, other drawings requiring low voltage cabling, and in the applicable specifications. All raceway systems shall be installed completely, including

wire clips and grommets where required by the manufacturer's installation sheets or recommended by the Manufacturer's representative.

- F. Install surface raceways and fittings in accordance with local codes and applicable sections of the NECA "Standard of Installation".
 - 1. Fasten surface raceway base to the building structure and surfaces.
 - 2. Arrange supports to prevent misalignment during wiring installation.
 - 3. Maintain 12-inch clearance between surface raceway and surfaces with temperatures exceeding 104 degrees F.
 - 4. Cut raceways square as recommended by manufacturer.
 - 5. Ground and bond surface raceway as required.
 - 6. Securely fasten surface raceway supports, boxes, to ceiling, walls, with Rawl Plugs or approved equal anchors. Use lead cinch anchors or pressed anchors for heavy strain. Use only cadmium plated or galvanized bolts, screws.
 - 7. Route all surface raceways perpendicular or parallel to building lines.
 - 8. Completely install each surface raceway run prior to pulling conductors. All surface raceways are to be accessible after completion of construction.

- G. All surface raceways must be kept dry and free of water or debris.

- H. Install all surface raceways in the most direct, neat, and workmanlike manner to conserve building space and not obstruct equipment service space or interfere with use of space.

- I. Run surface raceway to avoid proximity to heat producing equipment, piping, and flues, keeping a minimum of 12-inches clear.

- J. Install surface raceway as a complete system, without conductors, continuous from outlet to outlet and from fitting to fitting. Fasten the entire surface raceway into position prior to conductor installation.

- K. Dual channel raceway shall be used to physically separate cabling not permitted to be routed in the same conduit as other cabling, refer to the respective drawings and specification sections related to the specific cabling to be installed.

END OF SECTION

SECTION 26 05 33 - CONDUIT SYSTEMS

PART 1 – GENERAL

1.1 WORK INCLUDED

- A. Furnish and install a complete system of electrical conduits and fittings.

1.2 REFERENCE STANDARDS

- A. National Electrical Code
- B. Local codes and ordinances
- C. UL
- D. ETL

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS – Provide products manufactured in the USA

- A. Raceways:
 - 1. Allied, International Metal Hose, Ipex, Heritage Plastics, Wheatland, Can-Tex, Carlon, Certain-Teed, Anamet, Inc., Electri-Flex Co., Western Tube and Conduit.
 - 2. PVC Coated RGC: Robroy Perma Cote, Robroy Plasti-Bond, or Calbond – no exceptions
 - 3. Stainless Steel: Robroy, Calbrite, Gibson
 - 4. Aluminum: Penn Aluminum, American Conduit, Wheatland, Eaton B-Line, Patriot Aluminum Products
- B. Fittings:
 - 1. Appleton, Crouse Hinds, Topaz, Steel City, O.Z. Gedney, Carlon, Heritage Plastics, Raco, Ipex, International Metal Hose, Lew Electric Fittings Co.
 - 2. PVC Coated ferrous fittings: Robroy Perma Cote, Robroy Plasti-Bond, or Calbond – no exceptions
 - 3. Stainless Steel: Robroy, Calbrite, Gibson, Crouse Hinds
 - 4. Aluminum: Penn Aluminum, American Conduit, Wheatland, Eaton B-Line, Patriot Aluminum Products
- C. Condulets and Conduit Bodies:
 - 1. Appleton, Form 85
 - 2. PVC Coated: Robroy Perma-cote or Plasti-Bond, – no exceptions
 - 3. Stainless Steel: Robroy, Calbrite, Gibson, Crouse Hinds
- D. Steel MC Cable for light fixture whips:
 - 1. AFC
 - 2. Southwire
 - 3. General Cable
 - 4. Kaf-Tech

2.2 GENERAL

- A. The minimum conduit size shall be $\frac{3}{4}$ -inch unless indicated otherwise in Divisions 26, 27 or 28.

1. Branch Circuits: Minimum conduit size shall be $\frac{3}{4}$ -inch.
 2. Feeder Circuits: Minimum conduit size shall be $\frac{3}{4}$ -inches.
 3. Technology, telecommunications, and low voltage systems: The minimum conduit size shall be $\frac{3}{4}$ -inches unless noted or indicated otherwise.
 4. The minimum conduit size between buildings for technology, voice, data, fire alarm, video, security, surveillance, BMCS, and other telecommunications shall be 2-inch unless indicated otherwise.
- B. The minimum conduit size for flexible metallic conduit for tap connections to individual light fixtures shall be $\frac{1}{2}$ inch, or steel metal clad (MC) cable with insulated ground conductor maximum 6 feet.
- C. Electrical nonmetallic tubing, flexible polyethylene or PVC tubing shall not be used on this project.
- D. BX and AC cable shall not be used on this project.
- E. PVC elbows shall not be used on this project.
- F. Intermediate metal conduit (IMC) shall not be used on this project.

2.3 RIGID METAL CONDUIT

- A. UL labeled, Schedule 40:
1. Mild steel pipe, zinc coated inside and out
 2. Aluminum Alloy 6063, T-1 temper
 3. Threaded ends
 4. Insulated bushings
- B. Fittings shall meet the same requirements as rigid metal conduits.
1. UL labeled
 2. Threaded fittings

2.4 ELECTRICAL METALLIC TUBING (EMT)

- A. UL labeled, standard weight:
1. Cold rolled steel tubing, zinc coated inside and out
 2. Aluminum Alloy 6005, 6063. Temper T-1
- B. Fittings shall meet the same requirements as EMT conduits.
1. UL labeled
 2. Insulated throat connectors
 3. Steel fittings with setscrews with lock nuts on threaded ends, no snap locks
 4. Cast metal fittings are not approved
 5. Uni-couple type connectors are not approved
 6. Split ring, anti-short bushings are not approved

2.5 PVC COATED RIGID STEEL WITH URETHANE INTERIOR COATING

- A. The PVC coated galvanized rigid conduit and fittings must be ETL Listed and Verified. The PVC coating must have been investigated and verified by ETL as providing the primary corrosion protection for the rigid metal conduit. Ferrous fittings for general service locations must be ETL Listed with PVC as the primary corrosion protection. Hazardous location fittings, prior to plastic coating must be UL listed for the hazard conditions to which they are to be used. All conduit and fittings must be new, unused material. Applicable UL standards may include UL 6 Standard for Safety, Rigid Metal Conduit, and UL514B Standard for Safety, Fittings for Conduit and Outlet Boxes.

- B. The PVC coated galvanized rigid conduit and fittings must be ETL Verified to the Intertek ETL SEMKO High Temperature H₂O PVC Coating Adhesion Test Procedure for 200 hours. The PVC coated galvanized rigid conduit must bear the ETL Verified PVC-001 label to signify compliance to the adhesion performance standard.
- C. The conduit shall be hot dip galvanized inside and out with hot galvanized threads.
- D. A PVC sleeve extending one pipe diameter or two inches, whichever is less, shall be formed at every female fitting opening except unions. The inside sleeve diameter shall be matched to the outside diameter of the conduit.
- E. The PVC coating on the outside of conduit couplings shall have a series of longitudinal ribs 40 mils in thickness to protect the coating from tool damage during installation.
- F. Form 8 Condulets, ½-inch through 2-inch diameters, shall have a tongue-in-groove gasket to effectively seal against the elements. The design shall be equipped with a positive placement feature to ease and assure proper installation. Certified results confirming seal performance at 15 psig (positive) and 25 inches of mercury (vacuum) for 72 hours shall be available.
- G. Form 8 Condulets shall be supplied with plastic encapsulated stainless-steel cover screws.
- H. A urethane coating shall be uniformly and consistently applied to the interior of all conduit and fittings. This internal coating shall be a nominal 2 mil thickness. Conduit or fittings having areas with thin or no coating shall be unacceptable.
- I. The PVC exterior and urethane interior coatings applied to the conduit shall afford sufficient flexibility to permit field bending without cracking or flaking at temperatures above 30°F (-1°C).
- J. All male threads on conduit, elbows and nipples shall be protected by application of a urethane coating.
- K. All female threads on fittings or conduit couplings shall be protected by application of a urethane coating.
- L. Independent certified test results shall be available to confirm coating adhesion under the following conditions
 1. Conduit and conduit exposure to 150°F (65°C) and 95% relative humidity with a minimum mean time to failure of 30 days. (ASTM D1151)
 2. The interior coating bond shall be confirmed using the Standard Method of Adhesion by Tape Test (ASTM D3359).
 3. No trace of the internal coating shall be visible on a white cloth following six wipes over the coating which has been wetted with acetone (ASTM D1308).
 4. The exterior coating bond shall be confirmed using the methods described in Section 3.8, NEMA RN1. After these tests the physical properties of the exterior coating shall exceed the minimum requirements specified in Table 3.1, NEMA RN1.
- M. Right angle beam clamps and U bolts shall be specially formed and sized to snugly fit the outside diameter of the coated conduit. All U bolts shall be provided with plastic encapsulated nuts that cover the exposed portions of the threads.
- N. All fittings, clamps, straps, struts, and hardware used with PVC coated conduit shall be

PVC coated or 316 stainless steel

2.6 STEEL FLEXIBLE CONDUIT

- A. Steel flexible metallic conduit:
 - 1. Zinc coated inside and out
 - 2. 18-inches minimum length, 24-inches maximum length
- B. Steel flexible metallic conduit for tap connections to light fixtures where steel MC Cable fixture whips are not used:
 - 1. 18 inches minimum length; 6 feet maximum length
- C. Liquid tight flexible steel conduit
 - 1. Type L.A. - Grounded - UL Approved
 - 2. 18-inches minimum length, 24-inches maximum length

2.7 PVC CONDUIT

- A. UL labeled Schedule 40 and Schedule 80
- B. PVC fittings and solvent welded joints
- C. Acceptable PVC conduit manufacturer: Ipex, Cantex

2.8 CONDULETS AND CONDUIT BODIES

- A. UL Labeled
- B. Form 85
- C. PVC Coated: Form 8
- D. LBC Condulets shall be used for size 2 inch and above.
- E. LL and LR Condulets shall not be used for 2 inch and above

2.9 ROOF MOUNTED CONDUIT AND BOX SUPPORTS

- A. Conduit supports and pads suitable for direct sunlight, conduit size, weight, quantity and roof system with unistrut supports and accessories. Conduit supports shall allow for conduit expansion and contraction.
- B. Refer to roofing specifications for additional information. The limitations and restrictions contained in any roofing specification shall prevail and supercede these specifications for roof mounted supports for conduits and boxes.
- C. Approved Manufacturer:
 - 1. Portable Pipe Hangers
 - 2. Eaton B-Line
 - 3. Miro Industries, Inc.

2.10 ALUMINUM CONDUIT

- A. UL Labeled
- B. Aluminum fittings shall meet the same requirements of aluminum conduits, compatible steel fittings.
 - 1. UL Labeled for use with aluminum conduit.

2.11 STAINLESS STEEL CONDUIT

- A. UL Labeled
- B. Rigid Stainless Steel:
 - 1. Type 304 Stainless Steel
 - 2. Threaded ends
 - 3. Insulated Bushings
- C. EMT:
 - 1. Type 304 Stainless Steel
 - 2. Compression Fittings
 - 3. Insulated Bushings
- D. Fittings, elbows, nipples, strut, device box, clamps straps, etc.
 - 1. Type 304 Stainless Steel

2.12 EXTERIOR IN-GRADE PULL BOXES

- A. Enclosures, boxes and covers are required to conform to all test provisions of the most current American Association of State Highway and Transportation Officials (AASHTO) standards for H-20 loading applications.
 - 1. AASHTO H-20 certified precast concrete, cast iron or other AASHTO recognized materials, rated for deliberate traffic.
 - 2. Conduit entry knock-outs as required
 - 3. Bolt down galvanized steel/cast iron covers
 - 4. Thin wall knocks outs as required
 - 4. Integral bottom
 - 5. Box height as required for specified conduit depth and required top elevation.
 - 6. Concrete design strength of minimum 5,500 PSI at 28-days
 - 7. Place enclosures on a minimum of 6 inches of coarse gravel with a border of 6-inches beyond the enclosures exterior dimension.
 - 8. Size and volume as required for application.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install electrical conduits and fittings for all wiring of any type unless specifically specified or instructed to do otherwise. Install conduits and fittings in accordance with local codes and applicable sections of the NECA “Standard of Installation”, concealed where possible.
 - 1. Fasten conduit supports to building structure and surfaces; do not support to roof deck.
 - 2. Arrange supports to prevent misalignment during wiring installation.
 - 3. Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports.
 - 4. Do not attach conduit to ceiling support wires.
 - 5. Arrange conduit to maintain head room and present neat appearance.
 - 6. Maintain 4-inch clearance between conduit and rooftop surfaces.
 - 7. Cut conduit square using saw or pipe cutter; de-burr cut ends.
 - 8. Bring conduit to shoulder of fittings; fasten securely.
 - 9. Conduit penetrations to all individual motor controllers, VFDs, and motor control cabinets shall only be made at the bottom of the enclosure. For other equipment, provide listed water sealing conduit hubs to fasten conduit to sides or tops of electrical equipment enclosures, device box, gutter, wireway, disconnect, etc.

10. Use suitable caps to protect installed conduit against entrance of dirt and moisture.
 11. Ground and bond conduit as required.
 12. Identify conduit as required.
 13. Route all conduits above building slab perpendicular or parallel to building lines.
 14. Do not use no-thread couplings and connectors for galvanized steel, PVC coated galvanized steel, or aluminum rigid conduit.
- B. Group related conduits; support using conduit rack. Construct rack using steel channel; provide space on each for 25 percent additional conduits.
- C. In areas where raceway systems are exposed and acoustical or thermal insulating material is to be installed on walls, partitions, and ceilings, raceways shall be blocked out proper distance to allow insulating material to pass without cutting or fitting. Also provide Kindorf galvanized steel channels to serve as standoffs for panels, cabinets and gutters.
- D. Securely fasten conduits, supports and boxes, to ceiling (not roof deck), walls, with Rawl Plugs or approved equal anchors. Use lead cinch anchors or pressed anchors. Use only cadmium plated or galvanized bolts, screws. Plastic anchors and lead anchors shall not be used for overhead applications.
- E. Provide separate raceway systems for each of the following when specified, indicated or required:
1. 120/208 volt circuits
 2. 277/480 volt circuits
 3. Emergency
 - a. Life safety branch
 - b. Critical branch
 - c. Equipment branch
 4. Voice/Data
 5. Sound reinforcement
 6. Theatrical and Architectural Dimming Controls
 7. MATV/CATV
 8. Security CCTV
 9. Security System
 10. Communications / PA Systems / Sound System Line Input and Speakers
 11. Fire Alarm
 12. Lighting and Building Management Control Systems
- F. Unless shown otherwise, do not install conduit in or below concrete building slabs.
- G. Unless shown otherwise, do not install conduit horizontally in concrete slabs.
- H. Roof penetrations shall be made in adequate time to allow the roofing installer to make proper flashing. Conduit for equipment mounted on roof curbs shall be routed through the roof curb. Conduit, gutters, pull boxes, junction boxes, etc. shall not be routed on roof unless specified otherwise. Where specifically indicated to be routed or mounted on the roof, supports shall be as specified, as recommended by roofing manufacturer and roof support manufacturer and as required by NEC. Place supports every five feet along conduit run and within 3 feet of all bends, condulets, and junction boxes. Provide roofing pad under stands at directed by Architect and as recommended by roofing manufacturer and roof support manufacturer. Provide additional unistrut supports and accessories as required.
- I. PVC coated conduit shall have all nicks and cuts to the protective coating repaired using manufacturer's approved touch-up material as recommended by manufacturer. Provide a

minimum of two-wraps of 3M-50 type tape over touch-up.

- J. Installation of the PVC Coated Conduit System shall be performed in accordance with the Manufacturer's Installation Manual. To assure correct installation, the installer shall be certified by Manufacturer to install coated conduit. Submit copies of training certification with submittal. Contractor shall coordinate installation with manufacturer's representative for field training and observation of installed PVC coated rigid galvanized conduit and fittings. Manufacturer's representative shall certify the installation is in accordance with manufacturer's installation instructions. Submit copies of installation certification prior to cover-up of underground installation.
- K. All conduit terminations at locations including but not limited to, switchgear, pull boxes, outlet boxes, stub-up, and stub-outs:
 - 1. Provide insulated throat connectors for EMT conduits.
 - 2. Provide insulated bushing on all rigid conduit terminations.
 - 3. Provide locknuts inside and outside of all boxes and enclosures.
 - 4. Provide threaded type plastic bushing at all boxes and enclosures
- L. In suspended ceilings, support conduit runs from the structure, not the ceiling system construction.
 - 1. Do not support from structural bridging.
 - 2. Do not support from metal roof deck.
- M. Completely install each conduit run and all bushings prior to pulling conductors. All boxes are to be accessible after completion of construction.
- N. All conduits must be kept dry and free of water or debris with approved pipe plugs or caps. Cap or plug conduit ends prior to concrete pouring.
- O. Ream ends of conduits after cutting and application of cutting die to remove rough edges.
- P. Install all above concrete slab conduits perpendicular or parallel to building lines in the most direct, neat and workmanlike manner.
 - 1. Cable Tension:
 - a. 0.008 lb./cmil for up to 3 conductors, not to exceed 10,000 pounds.
 - b. 0.0064 lb./cmil for more than 3 conductors, not to exceed 10,000 pounds
 - c. 1000 lbs. per basket grip.
 - 2. Sidewall pressure: 500 lbs./ft.
 - 3. Conduit runs within the following limits of bends and conduit length between pull points shall not exceed the above installation pulling tension and sidewall pressure limits.
 - a. Three (3) equivalent 90-degree bends: not more than fifty feet (50') between pull points.
 - b. Two (2) equivalent 90-degree bends: not more than one hundred feet (100') between pull points.
 - c. One (1) equivalent 90-degree bend: not more than one hundred fifty feet (150') between pull points.
 - d. Straight pull: not more than two hundred feet (200') between pull points.
 - 4. Indicate sizes of conduits, wireway sections, and cable tray sections on the as-built drawings.
 - 5. Hold horizontal and vertical conduits as close as possible to walls, ceilings and other elements of the building construction. Conduits shall be kept a minimum of 6 inches clear of roof deck / insulation, and 2 inches clear of above floor deck / insulation.
 - 6. Install conduits to conserve building space and not obstruct equipment service space or interfere with use of space. Conduit shall not be routed on floors, paved

- areas or grade.
7. Where a piece of equipment is wired from a switch or box on adjacent wall, the wiring shall go up the wall from the box, across at or near the ceiling, and back down to the equipment. Wiring shall not block the walkway between wall and equipment.
 8. Horizontal runs of conduit on exposed walls shall be kept to a minimum.
 9. Conduit for mechanical / plumbing equipment installed outdoors shall be routed with the associated mechanical / plumbing pipe support rack system where practical, coordinate with Divisions 22 and 23.
 10. Conduits installed in public areas, not concealed by architectural ceilings, shall be supported by galvanized steel channel racks to bottom of roof deck or floor deck. Conduits shall be grouped for neat workman-like appearance.
- Q. Install expansion and deflection fittings and bonding jumpers on straight runs which exceed 200-feet, on center, and at 200-foot maximum, on center, on straight runs which exceed 400-feet, and where conduits cross building expansion joints.
- R. Provide grounding bushings at concentric/eccentric knockouts or where reducing washers are used.
- S. Run conduit to avoid proximity to heat producing equipment, piping surfaces with temperatures exceeding 104 degrees F., and flues, keeping a minimum of 13-inches clear.
- T. Install conduit as a complete system, without conductors, continuous from outlet to outlet and from fitting to fitting. Make up threaded joints of conduit carefully in a manner to ensure a tight joint. Fasten the entire conduit system into position. A run of conduit between outlet and outlet, between fitting and fitting, or between outlet and fitting shall not contain more than the equivalent of four quarter bends, including those bends located immediately at the outlet or fitting.
- U. Conceal conduit systems in finished areas. Conduit may be exposed in mechanical and electrical rooms, and where otherwise shown or indicated only. Run the conduit parallel and perpendicular to the structural features of the building and support with malleable iron conduit clamps at intervals as required by NEC or on conduit racks, neatly racked and bent in a smooth radius at corners.
- V. Conduit bends shall be factory elbows or shall be bent using equipment specifically designed to bend conduit of the type used to maintain the conduit's UL listing. Conduit hanger spacing shall be 10 feet or less and as required by the NEC for all conduit. Beam clamp attachments to steel joist chords is prohibited. Beam clamps may only be used at beams, no exceptions. Connections to joists shall be made with galvanized channel extended between joist chords or with galvanized channel bearing on the vertical legs of joist chord angles.
- W. Support conduit on galvanized channel, using compatible galvanized fittings (bolts, beam clamps, and similar items), and galvanized threaded rod pendants at each end of channel and secure raceway to channel and channel to structure. Where rod pendants are not used, channel supports are to be secured to structure at each end. Conduit supports are to be secured to structure using washers, lock washers, nuts and bolts or rod pendants; use of toggle bolt "wings" are not acceptable. Support single conduit runs using a properly sized galvanized conduit hanger with galvanized closure bolt and nut and threaded rod. Raceway support system materials shall be galvanized and manufactured by Kindorf, Unistrut, Superstrut, Caddy, or Spring Steel Fasteners, Inc. Provide chrome or nickel-plated escutcheon plates on conduit passing through walls and ceilings in finished areas. Do not support conduit from other conduit, structural bridging or fire rated

ceiling system. Do not support more than one conduit from a single all-thread rod support. Provide electrical insulating sleeve or wrapping for aluminum conduit supported by zinc coated supports or fasteners. Channel supports shall have cut ends filed smooth. When installed outside of the building, or in areas subject to moisture, the cut ends shall be painted with ZRC galvanized paint or equivalent.

- X. Terminate all motor connection conduits in mechanical room spaces with a floor pedestal and with "Tee" conduit at motor outlet height for flexible conduit.
- Y. Where conduit is not embedded in concrete or masonry, conduit shall be firmly secured by approved clamps, half-straps or hangers. Tie wire and short pieces of conduit used as supports and or hangers are not approved.
- Z. Where "LB" condulets are used, 2-inches and larger shall be type "LBD".
- AA. No more than 12 conduits containing branch circuits may be installed in junction boxes, pull boxes or gutters.
- BB. Flexible metal conduit and liquid tight flexible metal conduit shall only be used for final connections from junction box to the following: motorized equipment, transformers, interior light fixtures above ceilings, and power poles. They shall not be used in lieu of rigid conduit runs. They shall not be used for wall or roof penetrations except for exterior building mounted light fixtures and installed in a PVC coated RGC conduit sleeve at least one size larger than the OD of the flexible conduit.
- CC. Where 3-1/2-inch conduit is specified and the required or specified material is Schedule 80 PVC, provide 4-inch conduit.
- DD. "Daisy Chaining" light fixtures installed for lay-in ceiling areas is not allowed. Each light fixture shall have its own fixture whip from junction box. The only exception being light fixtures installed end to end using chase nipples between them, or light fixtures recessed in non-accessible ceilings.
- EE. In above ceiling applications, do not install raceways, junction boxes, gutters, disconnects, etc. within 36 inches directly in front of HVAC control boxes or other equipment requiring access from a point starting from the top of control box / equipment down to ceiling.
- FF. Do not install conduit, junction boxes, etc. within 18 inches of outside edges of roof access openings.
- GG. Install minimum size 2-inch nipple, at least one, between multi-sectional panels for branch circuit independent of feeder conductors.

3.2 CONDUITS

- A. Conduit above grade indoors:
 - 1. Concealed Conduits: EMT with steel set screw fittings
 - 2. Exposed conduits:
 - a. Below nine feet AFF where not directly attached and against building walls, ceiling, or structure: Rigid metal conduit.
 - b. Where subject to physical damage: Rigid metal conduit.
 - c. Wet locations: PVC coated galvanized rigid steel or aluminum conduit
 - d. Damp Locations: Aluminum rigid conduit.
 - e. Exposed conduits in mechanical rooms or electrical rooms shall be rigid galvanized steel when installed below 18-inches above finished floor.

- B. Conduit installed above grade outdoors:
 - 1. Galvanized rigid steel for conduits up utility poles and where subject to physical damage or where located less than four feet above finished floor.
 - 2. Aluminum where not subject to physical damage and where located four feet above finished floor.

- C. Conduit where indicated underground:
 - 1. PVC Coated Galvanized rigid steel conduit elbows and Schedule 80 PVC, or PVC coated galvanized steel straight run conduits. PVC conduits for underground branch circuits shall be Schedule 80 or Schedule 40 PVC.
 - a. PVC conduit and fittings shall be used only for straight horizontal runs and for vertical risers at site lighting pole bases. Bending straight sections of PVC conduit to less than 25-foot radius or the use of PVC factory bends is not allowed.
 - b. Change in direction of conduit runs, either vertical or horizontal, shall be with PVC coated galvanized steel elbows or long sweep bends of straight PVC conduit sections. Long sweep bends of straight PVC 20-foot sections shall have a minimum radius of curvature of 25 feet and a maximum arc of 22.5degrees. Multiple long sweep bends of straight PVC sections shall be separated by a minimum of 20-feet of straight, linear, PVC sections.
 - c. Provide PVC coated rigid galvanized steel conduit elbows and fittings with urethane interior coating at all changes in direction with radius of less than 25-feet and at all vertical runs to 18 inches above finished floor elevation. For interior slab penetrations, provide continuous PVC coated rigid galvanized steel conduit and fittings with urethane interior coating from change in direction to 18 inches above finished floor elevation, except where stubbed-up under and inside equipment or switchgear where conduit shall be terminated at minimum two inches above concrete housekeeping pad.
 - d. Elbows for underground electrical service entrance, feeders, transformer primary / secondary, telecommunication, and low voltage conduits shall be PVC coated rigid galvanized steel with long radius as follows:
 - 1) Up to 1-inch conduit, minimum 12-inch radius.
 - 2) 1.5-inch conduit, minimum 18-inch radius.
 - 3) 2-inch conduit, minimum 24-inch radius.
 - 4) 2.5-inch conduit, minimum 30-inch radius.
 - 5) 3-inch conduit, minimum 36-inch radius.
 - 6) 3.5 to 6-inch conduit, minimum 48-inch radius.
 - e. Conduit for all floor boxes shall be routed below building slab from floor box to nearest column, wall, or as indicated.
 - f. Conduits shall not be routed horizontally in building slab, grade beams or pavement.
 - 2. Underground conduits:
 - a. Concrete encasement for utility installed conductors shall be as specified by the utility and comply with their standards and specifications.
 - c. Provide conduit spacers for parallel branch/feeder conduits.
 - d. Conduits either specified or approved in writing to be routed under building slab for electrical branch circuits or voice / data / video / communications horizontal drops or outlets shall be installed 18 inches below finished floor and on select fill. All other conduits, including but not limited to electrical feeders, voice / data / video / communications vertical, riser, tie, trunk, or service cable conduits shall be installed 48-inches below finished floor and on select fill.
 - e. Use suitable manufactured separators and chairs installed 4 feet on centers. Securely anchor conduit at each chair to prevent movement

- during backfill placement.
3. Install building voice / data / video / communications main service conduits and electrical service transformer primary and secondary conduits with top of conduit 48-inches below finished grade or pavement. Voice / data / video / communications conduits and electrical service primary conduits for utility owned electrical service transformers shall also comply with the respective utility company requirements and standards. All other underground conduits outside of building other than voice / data / video / communications main service conduits and electrical service transformer primary and secondary conduits shall have top of conduit at 36 inches minimum below finished grade or pavement.
 4. Provide two "caution" plastic tapes at 6-inches and 18-inches below finished slab, grade, or pavement; identify as specified in Section 26 05 00.
 5. Conduits located outside the building, provide magnetic locator tape at top of first compacted layer of backfill.
 6. During construction, partially completed underground conduits shall be protected from the entrance of debris such as mud, sand, and dirt by means of conduit plugs. As each section of the underground conduit is completed, a testing mandrel with diameter ¼-inch smaller than the conduit, shall be drawn through each conduit. A brush with stiff bristles shall be drawn through until conduit is clear of particles of earth, sand, or gravel. Conduit plugs shall then be installed.
 7. Utility underground conduit for Utility Company cable shall be installed per Utility Company standards, and their specifications for this project.
 8. Concrete shall be Portland Cement conforming to ASTM-C-150, Type 1, Type III or Type V if specified. Cement content shall be sufficient to product a minimum strength of 2,500 PSI.
 9. Contractor shall stake out routing and location of underground conduits using actual field measurements. He shall obtain approval of the Owner and Architect before beginning trenching, horizontal drilling, and excavation.
 10. Verify location and routing of all new and existing underground utilities with the Owner and Architect on the job site. Stake out these existing utilities so that they will not be damaged. Stake out new utilities to provide coordination with other trades and with new and existing utilities, easements, property lines, restricted land use areas, and right-of-ways. Verify existing public utilities with Call811.
- D. Conduit shown in concrete walls, floor or roof slab:
1. PVC Coated Galvanized Rigid steel.
- E. Conduits that penetrate concrete slabs, or within 100 feet of cooling towers, or at designated corrosive locations.
1. PVC coated galvanized rigid steel
- F. Connections to motorized equipment mounted on roof, rotating equipment, transformers, and kitchen or food processing equipment, or where flexible conduit is required outdoors.
1. Liquid tight flexible metal conduit (1/2 inch may be used for roof top supply / exhaust fans only)
 2. Liquid tight flexible metal conduit length shall be between 18 and 24 inches
 3. Conduit for roof-mounted equipment shall be routed inside the roof curb assembly roof opening. Provide permanent lock-off device at panelboard circuit breakers serving roof equipment and accessories to enable tag-out procedures for all power routed through roof curb and to the roof mounted equipment and accessories.
- G. Light fixture whips:
1. Accessible ceilings and open structure: ½-inch flexible steel conduit or steel MC cable, length not to exceed 6-feet.
 2. Non-accessible ceilings: ½-inch flexible steel conduit. Length as required to

- make a tap at an accessible j-box. Recessed light fixtures in non-accessible ceilings may be daisy chained using the light fixture's integral, UL listed j-box or internal wire way that is accessible through fixture from below the ceiling.
3. Dedicated insulated ground wire.
 4. Light fixture whips shall not rest on ceiling grid or tile.
 5. Light fixture whips shall not be supported from the ceiling suspension system. Support from the structure with #13 AWG galvanized iron wire pendants and Caddy clips. Do not support conduit from structural bridging. Flexible conduit and steel MC cable shall be kept a minimum of 2 inches clear of roof deck.
- H. Conduits at Natatorium or therapeutic pool areas:
1. Underground conduit shall be as specified in this section.
 2. Exterior conduits and boxes within 100 feet of exhaust openings shall be PVC coated galvanized rigid steel or stainless steel.
 3. Exposed conduits in chemical storage rooms, pool mechanical equipment (pump rooms, and pool equipment storage rooms shall be Schedule 80 PVC. Boxes shall be PVC, or 304 Stainless Steel.
 4. Exposed conduits and boxes in indoor pool areas and all other indoor public areas shall be Type 304 Stainless Steel.
- I. Conduits located inside greenhouses and natatorium pump and water treatment rooms:
1. Schedule 80 PVC
 2. PVC coated galvanized rigid steel conduit and fittings.

3.3 CONDUIT PENETRATIONS, SLEEVES AND ESCUTCHEONS

- A. Furnish sleeves for placing in construction for all conduit passing through concrete or masonry walls, partitions, beams, all floors other than grade level, and roofs. A conduit sleeve shall be one size larger than the size of conduit, which it serves except where larger sizes are required for manufactured water, fire, or smoke stop fittings.
1. Sleeves set in concrete floor construction shall be minimum Schedule 40 galvanized steel.
 2. Sleeves shall extend 3-inches above the finished floor.
- B. Sleeves in concrete or masonry walls shall be Schedule 40 galvanized steel. Sleeves shall be set flush with finished wall.
- C. Install manufactured UL listed water, fire, and smoke stop fittings, or caulk around conduit or cables in sleeves with sufficient UL listed fire safe insulation or foam to maintain wall or floor slab fire or smoke rating. Refer to Architecture drawings for locations of rated walls.
- D. Provide Linkseal Mechanical Seals around conduit penetrations through walls below grade. Provide a pull box to install a water stop inside wall penetration. Internally seal low voltage cabling conduit penetrations with waterproof caulking.
- E. Sleeves penetrating walls below grade shall be Schedule 40 black steel pipe with ¼-inch thick steel plate secured to the pipe with continuous fillet weld. The plate shall be located in the middle of the wall and shall be 2-inches wider all around than the sleeve that it encircles. The sleeve should extend a minimum of 24-inches on either side of the penetration. The entire assembly shall be hot-dipped galvanized after fabrication. Do not sleeve or penetrate grade beams.
- F. Conduit passing through the housing on connected equipment shall pass through a cleanly cut hole protected with a threaded steel bushing. Route conduit through roof openings, for piping and ductwork or through suitable roof jack, with pitch pocket. Coordinate location with roofing installation as required.

- G. Conduit passing through fire rated wall shall be sealed with Fire Stop. Route conduit to preserve fire resistance rating of partitions and other elements, using materials and methods under the provisions of Division 7.

3.4 POWER DISTRIBUTION UNDERGROUND FEEDER CONDUIT AND UNDERGROUND SERVICE ENTRANCE CONDUIT

- A. Power underground feeder and service entrance shall be of individual conduit. Unless shown otherwise, the type of conduit used shall not be mixed in any one underground conduit and shall be the size indicated on the drawings. Conduit for 120V and above shall be separated from control and signal conduits by a minimum of 3-inches.
- B. During construction, partially completed underground conduits shall be protected from the entrance of debris such as mud, sand, and dirt by means of conduit plugs. As each section of the underground conduit is completed, a testing mandrel shall be drawn through until each conduit is clear of particles of earth, sand, or gravel. Conduit plugs shall then be installed.
- D. Conduit for service entrance underground conduits shall be as indicated on the drawings.
- E. Primary power underground conduit shall be installed in accordance with utility company standards and the utility company specifications for this project.

3.5 TELECOMMUNICATIONS, LOW VOLTAGE AND EMPTY CONDUIT SYSTEM RACEWAYS

- A. Conduit shall be installed in accordance with the specified requirements for conduit and with the additional requirements that no length of run shall exceed 100-feet for 1 inch or smaller trade sizes and shall not contain more than two 90-degree bends or the equivalent. Pull or junction boxes shall be installed to comply with these requirements. Provide plastic bushings at all conduit terminations. Provide a grounding bushing on each data and voice conduit.
- B. Completely install all conduit runs and all bushings prior to pulling conductors. All boxes shall be accessible after completion of construction.
- C. Conduits shall be installed from outlet box to above an accessible ceiling. All cables routed through open spaces (no-ceiling below roof deck or above floor deck) shall be routed in conduit. Telecommunications systems, CATV, CCTV, fire alarm and BMCS cables can be installed above accessible ceilings without conduit. Cables installed above accessible ceiling shall be plenum rated. Conduit rough in of these cables shall include a 90-degree turn-out to an accessible location with insulated bushings on the end of the conduit.
 - 1. Provide conduit from each telecommunications outlet box to accessible ceiling plenum.
 - 2. Provide conduit from each security / surveillance device outlet box to accessible ceiling plenum.
 - 3. Provide two conduits for each multi-media outlet box and each outlet box indicated to contain more than four data, audio, or video drops to accessible ceiling plenum.
 - 4. Provide the following minimum conduits for telecommunications and multi-media wall, floor, and ceiling mounted outlet boxes. Use the largest diameter conduit indicated below unless instructed otherwise in writing from the Architect:
 - a. Non-masonry outlet box: Two 1-inch conduits.
 - b. Masonry outlet box: Two 1-inch conduits, or three 3/4-inch conduits.
 - c. Where indicated differently on plans or where conflicts arise, notify the

Architect / Engineer prior to installation.

- D. All conduit in which cable is to be installed by others shall have pull string installed. The nylon pull string shall have not less than 200 lb. tensile strength. Not less than 12-inches of slack shall be left at each end. Provide blank cover plate before substantial completion if box is for a future installation after substantial completion of the project. Conduit shall extend to a minimum six inches above nearest accessible ceiling and be turned horizontally with plastic bushing at terminations.
- E. Conduits for Building Entrance Facilities:
 - 1. Underground Outside Plant: Install a pull box every 300-feet or after 180 degree turns.
 - 2. Inside Plant: Install a pull box every 150-feet or after 180 degree turns. All turns shall be large sweeps, not sharp 90s, with the radius of the sweep at least 10X the diameter of the conduit. Hence, a 4-inch conduit requires a 40-inch minimum radial sweep. If field conditions absolutely mandate a sharp 90-degree bend to be installed, then a pull box shall be installed at that location regardless of distance.
 - 3. Building entrance facilities shall not terminate in an IDF or any other space except the MDF.
 - 4. Coordinate the termination location of the building entrance facilities in the MDF with the room layout and equipment configuration.
 - 5. Provide 4-inch conduit unless indicated otherwise. Provide (3) fabric innerducts in each 4-inch conduit.

3.6 EXTERIOR IN-GRADE PULL BOXES

- A. Provide pull boxes where specified and as required.
- B. Pull boxes located in pavement shall be set with proper extensions so that top of cover is flush with pavement.
- C. Pull boxes located in non-paved areas shall be set two-inches above surrounding finished grade. Provide 12-inch wide by 8-inch deep reinforced concrete crown around neck or opening and sloped down away from pull box opening.

3.7 IDENTIFICATION

- A. Conduit Systems: Provide adequate marking of conduit larger than one inch exposed or concealed in interior accessible spaces to distinguish each run as either a power (120/208V or 277/480V) or signal / telecommunication conduit (Fire Alarm, BAS, BMCS, Security, CCTV, Access Control, Intrusion Detection, Telecom, etc.). Except as otherwise indicated, use orange banding with black lettering. Provide self-adhesive or snap-on type plastic markers. Locate markers at ends of conduit runs, near switches and other control devices, near items of equipment served by the conductors, at points where conduit passes through walls or floors or enters non-accessible construction, and at spacing of not more than 50-feet along each run of exposed conduit. Switch-leg conduit and short branches for power connections need not be marked, except where conduit is larger than 1-inch.

END OF SECTION

SECTION 26 05 35 - ELECTRICAL CONNECTIONS FOR EQUIPMENT

PART 1 – GENERAL

1.1 WORK INCLUDED

- A. Electrical connections as required and scheduled, and as specified.

1.2 RELATED WORK

- A. Refer to other Divisions for specific individual equipment electrical requirements.

1.3 QUALITY ASSURANCE

- A. UL Label: Products shall be UL listed to the extent possible.

PART 2 – PRODUCTS

2.1 MATERIALS AND COMPONENTS

- A. General: For each electrical connection indicated, provide a complete assembly including, but not limited to, pressure connectors, terminals (lugs), electrical insulating tape, heat-shrinkable insulating tubing, cable ties, solderless wire nuts, and other items and accessories needed to complete splices and terminations.
- B. Raceways: Refer to related sections.
- C. Conductors and Connectors: Refer to related section. Conductors at equipment terminations shall be copper.
- D. Terminals: Provide electrical terminals as indicated by the terminal manufacturer for the application.

PART 3 – EXECUTION

3.1 INSTALLATION OF ELECTRICAL CONNECTIONS

- A. General: Install electrical connections as shown, in accordance with applicable portions of the NECA Standard of Installation, and industry practices.
- B. Conductors: Connect electrical power supply conductors to equipment conductors in accordance with equipment manufacturer's written instructions and wiring diagrams. Where possible, match conductors of the electrical connection for interface between the electrical supply and the installed equipment.
- C. Splice Insulation: Cover splices with electrical insulation equivalent to, or of a higher rating than, insulation on the conductors being spliced.
- D. Appearance: Prepare conductors by cutting and stripping covering, jacket, and insulation to ensure a uniform and neat appearance where cables and wires are terminated.
- E. Routing: Trim cables and wires to be as short as practical. Arrange routing to facilitate inspection, testing, and maintenance.

- F. Motor Connections: Where possible, terminate conduit in conduit boxes at motors. Where motors are not provided with conduit boxes, terminate the conduit in a suitable conduit, and make motor connections. Conduit passing through the housing on connected equipment shall pass through a cleanly cut hole protected with an approved grommet. For all AHU or fan motors and all other motors 10 HP and larger, at the motor connection do not use wire nuts. Provide copper alloy split bolt connectors or compression lugs and bolts. Insulate connection with Scotch Super 88 vinyl electrical tape over rubber tape, or Tyco Gelcap Motor Connection Kit.
- G. Conduit connections to equipment including, but not limited to, Variable Frequency Drives, Manual and Automatic Transfer Switches, Surge Suppression Devices, motor controllers, electrical disconnects, food service / processing equipment, electronics, control panels and Owner furnished equipment:
 - 1. Make conduit penetrations only at the bottom flat surface of the equipment and only where permitted by the equipment manufacturer to avoid un-intentional water entry. Coordinate installation of electrical connections for equipment with equipment installation work. Where equipment manufacture does not permit a bottom conduit entry, verify with Owner/Engineer and locate the conduit entry at the side surface as close as possible to the bottom of the enclosure.
 - 2. Where conduit originates from an elevation above the conduit entry, provide a "T" conduit below the enclosure's bottom elevation. Provide conduit from the conduit up to the enclosure bottom horizontal surface for electrical connection.
- H. Identification: Refer to Electrical General Provisions for identification of electrical power supply conductor terminations with markers approved as to type, color, letter and marker size by the Architect. Fasten markers at each termination point, as close as possible to each connecting point.
- I. Equipment and Furnishings: Refer to other Divisions. Coordinate power and control provisions shown for equipment and furnishings with the provisions required for the furnished equipment and furnishings. Where the power and control requirements are less than or equal to those specified, modifications to power and control provisions shall be made at no cost as a part of coordination. Where power and control requirements are in excess of those shown, notify the Architect in writing of the requirements.
- J. Elevators and Escalators, and Wheelchair Lifts: Refer to Other Divisions. Coordinate power and control provisions shown with the provisions required for the furnished equipment. Where the power and control requirements are less than or equal to those specified, modifications to power and control provisions shall be made at no cost as a part of coordination. Where power and control requirements are in excess of those shown, notify the Architect in writing of the requirements. Provide lockable disconnect switches for main power, control power, lighting power, etc. as required by the NEC and all local codes. Provide all necessary means of two-way communication for emergency phones.

END OF SECTION

SECTION 26 05 37 - ELECTRICAL BOXES AND FITTINGS

PART 1 – GENERAL

1.1 WORK INCLUDED

- A. Provide electrical box and fitting work as required, scheduled, indicated, and specified.

1.2 QUALITY ASSURANCE

- A. UL Label: Electrical boxes and fittings shall be UL listed.

PART 2 - PRODUCTS– Provide products manufactured in the USA

2.1 FABRICATED MATERIALS

- A. Interior Outlet Boxes: Provide galvanized steel interior outlet wiring boxes, of the type, shape, and size, including depth of box, to suit respective locations and installation. Construct with stamped knockouts in back and sides. Provide gang boxes where devices are shown grouped. Single box design; sectional boxes are not acceptable, except for wall mounted electronic displays.
 - 1. Type of Various Locations:
 - a. Wall mounted interactive media boards, video displays, televisions, electronic signage and similar installations; recessed wall mounted box for power and/or multi-media (low voltage) outlets: Arlington Industries #TVBS 613, 4-gang steel box with white trim plate.
 - b. Technology, data, voice, video and multi-media outlet boxes at locations other than wall mounted interactive media boards, video displays, televisions, electronic signage and similar installations: minimum 4-inch square (2-gang), 3-inch deep interior outlet boxes. Raco #260H large capacity box with ½ through 2-inch knockouts.
 - c. Security, access control, and video surveillance outlet boxes: single gang, 3-inch deep outlet boxes mounted long axis vertically.
 - d. All other applications: minimum 4-inch square (2-gang) 2-1/8-inch deep boxes.
 - e. Masonry Walls: Galvanized switch boxes made especially for masonry installations; depths of boxes must be coordinated for each installation.
 - f. Surface: Type FS or FD box with surface cover.
 - g. Corrosive locations or natatorium areas: 316 stainless steel construction suitable for the installation.
 - h. Hazardous (Classified) Locations: Explosion proof boxes, seals and fittings.
 - i. Special: Where above types are not suitable, boxes as required, taking into account space available, appearance, and Code requirements
 - 2. Interior Outlet Box Accessories: Outlet box accessories required as for installation, including covers or wall device plates, mounting brackets, wallboard hangers, extension rings, plaster rings for boxes in plaster construction, fixture studs, cable clamps and metal straps for supporting outlet boxes. Accessories shall be compatible with outlet boxes used and meet requirements of individual wiring.

- B. Damp Location Outlet and Damp or Wet Location Switch Boxes: Deep type, hot dipped galvanized cast-metal weatherproof outlet wiring boxes, of type, shape, and size required. Include depth of box, threaded conduit ends, and stainless steel cover plate with spring-hinged waterproof caps suitable for application. Include faceplate gasket and corrosion-resistant, tamper / vandal proof fasteners.
- C. Wet Location Outlet Boxes: Hot dipped galvanized cast-iron weatherproof outlet wiring boxes, of type, shape, and size required. Include depth of box, threaded conduit ends.
- D. Junction and Pull Boxes: Galvanized sheet steel junction and pull boxes, with screw-on covers, of type, shape, and size, to suit respective location and installation.
 - 1. Type for Various Locations:
 - a. Minimum Size: 4-inch square, 2-1/8-inches deep.
 - b. 150 Cubic Inches in Volume or Larger: Code gauge steel with sides formed and welded, screw covers unless shown or required to have hinged doors. All boxes mounted above ceiling shall have screw covers. Boxes in all other areas with covers larger than 12-inches shall have hinged with screw covers. Knockouts factory stamped or formed in field with a cutting tool to provide a clean symmetrically cut hole.
 - c. Exterior or Wet Areas: 304 stainless steel NEMA 4X construction with gaskets and corrosion-resistant fasteners
- E. Conduit Bodies: Provide galvanized cast-metal conduit bodies, of type, shape, and size, to suit location and installation. Construct with threaded conduit ends, removable cover, and corrosion-resistant screws.
- F. Bushings, Knockout Closures, and Locknuts: Provide corrosion-resistant punched-steel box knockout closures, conduit locknuts, and insulated conduit bushings of type and size to suit use and installation.
- G. Outlet boxes in fire rated walls: Provide 2-hour rated gasket within box and below cover, equal to Rectorseal Metacaulk box guard and cover guard.

PART 3 – EXECUTION

3.1 INSTALLATION OF BOXES AND FITTINGS

- A. Install electrical boxes and fittings as shown and as required, in compliance with NEC requirements, in accordance with the manufacturer's written instructions, in accordance with industry practices.
- B. Provide recessed device boxes for wall mounted interactive media boards, video displays, televisions, electronic signage and similar installations.
- C. Provide minimum 4-inch square (2-gang), 3-inch deep interior outlet boxes for technology, data, voice, video, and multi-media outlet boxes at locations other than wall mounted interactive boards, video or visual displays. Provide single gang only, 3-inch deep outlet boxes mounted long axis vertically for security, access control, and video surveillance, coordinate with security equipment installation. Provide minimum 4-inch square (2-gang) 2-1/8-inch deep boxes for all other applications. Where indicated differently on plans or where conflicts arise, notify the Architect / Engineer prior to installation. Box extenders or plaster rings shall not be used to increase size. Provide increased box size as required.

- D. Junction and pull boxes, condulets, gutters, located above grid ceilings shall be mounted within 18-inches of ceiling grid. Junction and pull boxes above grid ceilings shall be mounted in the same room served. Junction boxes and pull boxes required for areas with inaccessible ceilings shall be located above the nearest accessible ceiling area. All junction box or pull box openings shall be side or bottom accessible. Removal of light fixtures, mechanical equipment or other devices shall not be required to access boxes. Outlet boxes above ceiling for low voltage terminations shall face towards the floor.
- E. Use outlet and switch boxes for junctions on concealed conduit systems except in utility areas where exposed junction or pull boxes can be used.
- F. Determine from the drawings and by measurement the location of each outlet. Locate electrical boxes to accommodate millwork, fixtures, marker boards, and other room equipment at no additional cost to the Owner. The outlet locations shall be modified from those shown to accommodate changes in door swing or to clear interferences that arise from construction as well as modifying them to center in rooms. The modifications shall be made with no cost as part of coordination. Check the conditions throughout the job and notify the Architect of discrepancies. Verify modifications before proceeding with installation. Set wall boxes in advance of wall construction, blocked in place and secured. Set all wall boxes flush with the finish and install extension rings as required extending boxes to the finished surfaces of special furring or wall finishes. Provide wall box support legs attached to stud to prevent movement of box in wall.
- G. Unless noted or directed otherwise at installation, place outlet boxes as indicated on architectural elevations and as required by local codes.
- H. Outlets above counters, mount long axis horizontally. Refer to architectural elevations and coordinate to clear backsplash and millwork.
- I. Provide pull boxes, junction boxes, wiring troughs, and cabinets where necessary for installation of electrical systems. Surface mounted boxes below 9 feet and accessible to the public shall not have stamped knockouts.
- J. Provide weatherproof boxes for interior and exterior locations exposed to weather or moisture.
- K. Provide knockout closures to cap unused knockout holes in boxes.
- L. Locate boxes and conduit bodies to ensure access to electrical wiring. Provide minimum 12-inch clearance in front of box or conduit body access.
- M. Secure boxes to the substrate where they are mounted, or embed boxes in concrete or masonry.
- N. Boxes for any conduit system shall not be secured to the ceiling system, HVAC ductwork or piping system.
- O. Provide junction and pull boxes for feeders and branch circuits where shown and where required by NEC, regardless of whether or not boxes are shown.
- P. Coordinate locations of boxes in fire rated partitions and slabs to not affect the fire rating of the partition or slab. Notify the Architect in writing where modification or construction is required to maintain the partition or slab fire rating.

- Q. Exterior boxes installed within 50-feet of cooling towers or water treatment areas shall be of 304 stainless steel, weatherproof NEMA 4X construction.
- R. Identification: Paint the exterior and cover plates of building interior junction boxes and pull boxes located above accessible ceilings or non-finished areas to correspond to the following colors:
1. Orange: - 480/277 VAC systems
 2. Light Blue: - 240 VAC three phase delta systems.
 3. Red – All Emergency circuits, regardless of voltage, and fire alarm system.
 4. Light Green - 120/208 VAC 3 phase and 120/240 VAC single-phase systems
 5. Yellow – Building Management and Control System - BMCS
 6. White - Security and Surveillance equipment circuits
- S. All box covers shall be labeled with Panel ID and circuit numbers of all circuits available in box using permanent black marker. Boxes containing main feeders are to list where fed from and load (example “MSB to Panel HA”). Information listed is to be legible, markovers are not acceptable. Multi-sectional panel numbers are not to be listed on covers (example “LA2” referring to Panel LA sec. 2 is to be listed as “LA”). Label covers for special applications explaining contents (example “Emerg. Gen. Annunciator controls”, “IDF ground”). Do not attach box covers that have both sides painted or labeled differently. In public areas where boxes are painted same color as room per architect, label inside covers. Boxes that are not used shall be labeled as not used and include panel ID. Example “Not Used Panel LA”. Unused raceways not in sight of panel shall be terminated in a box and labeled not used and include panel identification.
- T. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.
- U. Use flush mounting outlet box in finished areas unless specifically indicated as being used with exposed conduit.
- V. Locate flush-mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.
- W. Do not install flush mounting box back-to-back in walls; provide minimum 6 inches with stud separation. Provide minimum 24 inches with separation in acoustic rated walls.
- X. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness. Provide UL listed materials to support boxes in walls to prevent movement. Ensure box cannot be pushed inside wall.
- Y. Use stamped steel bridges to fasten flush mounting outlet box between studs.
- Z. Install flush mounting box without damaging vapor barriers, wall insulation or reducing its effectiveness.
- AA. Use adjustable steel channel fasteners for hung ceiling outlet box.
- BB. Do not fasten boxes to ceiling support wires.
- CC. Support systems are to hang vertically straight down. All-thread supports, when used, are not to be installed at an angle or bent.

- DD. Use gang box where more than one device is mounted together. Do not use sectional box.
- EE. Use gang box with plaster ring for single device outlets.
- FF. Support outlets flush with suspended ceilings to the building structure.
- GG. Mount boxes to the building structure with supporting facilities independent of the conduits or raceways.
- HH. Where multiple feeders are in one pull box, conductors shall be wrapped with 3M No. 7700 Arc and fireproof tape.
- II. Provide plaster rings of suitable depth on all outlet boxes. Face of plaster ring shall be within 1/8 inch from finished surface.
- JJ. Equip boxes supporting fixtures designed to accept fixture studs with 3/8-inch stud (galvanized malleable iron) inserted through back of box and secured by locknut. Boxes not equipped with outlets shall have level metal covers with rust-resisting screws.
- KK. Do not mount junction boxes above inaccessible ceilings or in inaccessible spaces. Do not mount junction boxes above ceilings accessible only by removing light fixture, mechanical equipment or other devices. At inaccessible spaces use junction box furnished with light fixture or light fixture wiring compartment UL listed for through wiring.
- LL. No more than 12 conduits containing branch circuits may be installed in any junction or pull box.
- MM. All junction boxes shall be protected from building finish painters' over spray and from fire proofing overspray. Remove protective coverings when painting and fire proofing are complete.
- NN. Bond equipment grounding conductor to all junction and pull boxes.
- OO. Do not mount boxes or conduit bodies on walls directly above electrical panels or switchgear located next to walls.
- PP. Do not mount boxes or conduit bodies within 18 inches of outside edges of roof access openings.
- QQ. Box extenders or plaster rings shall not be used to increase the Code mandated cable capacity of a box. Provide proper size box.

3.2 ADJUSTING

- A. Adjust flush-mounting outlets to make front flush with finished wall material.
- B. Install knockout closures in unused box openings.

END OF SECTION

SECTION 26 05 40 - ELECTRICAL GUTTERS AND WIREWAYS

PART 1 – GENERAL

1.1 WORK INCLUDED

- A. Provide electrical gutter work as shown, as specified and as required.
- B. Application: The types of electrical gutters required for the project include the following:
 - 1. Electrical wiring gutters
 - 2. Voice / Data / Video / Communication and signal distribution wireway

1.2 QUALITY ASSURANCE

- A. UL Label: Gutters and wireways shall be UL labeled.

PART 2 – PRODUCTS

2.1 ELECTRICAL GUTTERS AND WIREWAYS

- A. General: Provide hinged electrical gutters and wireways in the types and sizes indicated or required, minimum 16 gauge thickness, with rounded edges and smooth surfaces; constructed in compliance with applicable standards; with features required.
- B. Size: Provide size indicated. Where size is not indicated, construct in accordance with the NEC and other standards. Gutters shall be of manufacturer's standard lengths, without field cutting or field extensions.
- C. Accessories: Provide gutter and wireway accessories where indicated, constructed of same metal and finish as gutters or wireways.
- D. Supports: Provide gutter and wireway supports indicated, conforming to NEC, and as recommended by the manufacturer, and as specified in Section 26 05 33 Conduit Systems.
- E. Materials and Finishes: NEMA 1 gutters and wireways shall have gray powder coat finish over galvanized steel. Gutters and wireways installed outside shall be NEMA 3RX minimum. Gutters or wireways installed within 100-feet of cooling towers, at kitchen or food preparation areas, and natatorium, spa or therapy pool areas shall be of 304 stainless steel NEMA 4X construction.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Provide gutters and wireways only where specified or required. Use of gutters and wireways shall be kept to a minimum.
- B. Finishing: Remove burrs and sharp edges of gutters and wireways wherever they could be injurious to conductor insulation or jacket.
- C. Installation: Install gutters and wireways where shown or required, in accordance with the manufacturer's written instructions, NEC, NECA "Standard of Installation," and with recognized industry practices to ensure that the gutters and wireways comply with the specified requirements. Comply with requirements of NEMA and the NEC pertaining to

installation of electrical gutters.

- D. Grounding: Electrically ground gutters and wireways to ensure continuous electrical conductivity. Provide equipment grounding conductor.
- E. Conductors:
 - 1. Complete gutter and wireway installation before starting the installation of conductors.
 - 2. Provide sufficient space to permit access for installing, splicing, and maintaining the conductors.
- F. A maximum of 12 conduits containing branch circuits shall be allowed to be installed in any gutter or wireway.

END OF SECTION

SECTION 26 05 50 – FIRESTOPS

PART 1 – GENERAL

1.1 WORK INCLUDED

- A. Provide firestop as required, and as specified. Refer to Architectural drawings for all fire and smoke rated partitions, walls, floors, etc.
- B. Types: Firestop required for the project includes smokestop.

1.2 QUALITY ASSURANCE

- A. UL Label: Firestops shall be UL labeled.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Nelson
- B. 3M (Minnesota Mining Manufacturing)
- C. Hilti
- D. Specified Technologies, Inc.
- E. Metacaulk

2.2 MATERIAL AND COMPONENTS

- A. General: Except as otherwise indicated, provide firestop manufacturer's standard materials and components as indicated by published product information, designed and constructed as recommended by the manufacturer, and as required for installation.

2.3 FIRESTOP

- A. Conduits: Provide a soft, permanently flexible sealant for 1-1/2 to 2 hour rated fireproofing for steel conduits (up to 4" diameter).
- B. Low Voltage Cables, Fiber Optic Cable and Innerduct: Provide Specified Technologies, Inc. EZ-Path single, double, or triple pathways as required.

PART 3 – EXECUTION

3.1 INSTALLATION OF FIRESTOPS

- A. General: Install firestops in accordance with the manufacturer's installation instructions and industry practices to ensure that the firestops comply with requirements. Comply with UL and NFPA standards for the installation of firestops.

END OF SECTION

**SECTION 26 08 00 - ELECTRICAL AND LIFE SAFETY SYSTEMS
TECHNICAL COMMISSIONING REQUIREMENTS**

PART 1 – GENERAL

1.1. RELATED DOCUMENTS

- 1.1.1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- 1.1.2. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.2. SUMMARY

- 1.2.1. The purpose of this Section is to define responsibilities in the Commissioning Process. Other electrical system testing is required under other Division 26 Specification Sections. National Electrical Installation Standards (NEIS) NECA 90-2004, "Recommended Practice for Commissioning Building Electrical Systems", 27th Volume of the NEIS Series, provides additional guidance for the commissioning of electrical systems.
- 1.2.2. Commissioning requires the participation of the Contractor to ensure that all systems are operating in a manner consistent with the Contract Documents. General Commissioning Requirements are provided separately and coordination is detailed in Division 01. Division 26 and 28 Contractors shall be familiar with all parts of Division 01, the General Commissioning Requirements and the Commissioning Plan issued by the Owner's CxA, shall execute all Commissioning responsibilities assigned to them in the Contract Documents and include the cost of Commissioning in the Contract price.
- 1.2.3. Electrical Testing Agency (ETA)
 - 1.2.3.1. The Contractor shall retain an independent Electrical Testing Agency (ETA). Their specific testing responsibilities are delineated in individual technical sections within Division 26. This generally requires checking and testing of the electrical power distribution equipment per National Electrical Testing Association (NETA) Acceptance Testing Standards (ATS).
 - 1.2.3.2. Attend, as needed, Pre-Commissioning Meeting(s), Pre-Installation Meeting(s), and other Project meetings scheduled by the Contractor, Owner or CxA to facilitate the Commissioning process.
 - 1.2.3.3. Obtain all required manufacturer's data to facilitate tests.
 - 1.2.3.4. Provide assistance to the CxA in preparation of the specific System Verification Checklists (SVC) and Functional Performance Test procedures.
 - 1.2.3.5. Generally, the ETA shall provide their standard forms to document the NETA tests to be incorporated into the System Verification Checklists and Functional Performance Test records.
 - 1.2.3.6. The ETA shall assist the Contractor in completing required SVC information such as relay settings, protective overload settings, and equipment ratings utilizing the protocols in the Commissioning Plan.

- 1.2.3.7. Perform and clearly document all completed Start-up and system operational checkout procedures, providing a copy to the Contractor.
- 1.2.3.8. Clearly indicate any deficiencies identified during testing and add to an action list for resolution and tracking. The field technicians shall keep a running log of events and issues.
- 1.2.3.9. Provide skilled technicians to execute testing. Ensure that they are available and present during the agreed-upon schedules and for sufficient duration to complete the necessary tests, adjustments and problem solving.
- 1.2.4. Electrical systems to be commissioned include the following:
 - 1.2.4.1. Unit Substations / Electrical Switchboards
 - 1.2.4.2. Secondary Normal Power Distribution
 - 1.2.4.3. Emergency / Standby Power Distribution
 - 1.2.4.4. Branch Power Distribution and Components
 - 1.2.4.5. Emergency Generators and Paralleling Switchgear
 - 1.2.4.6. Uninterruptible Power Supplies (UPS)
 - 1.2.4.7. Lighting Controls - Occupancy Sensors (25% greater than 25 sensors installed, 100% less than 25 sensors installed)
 - 1.2.4.8. Lighting - Daylight Controls (100%)
 - 1.2.4.9. Lighting - Time Switch Controls (100%)

1.3. DEFINITIONS

- 1.3.1. Refer to Division 01: General Commissioning Requirements for definitions.

1.4. SUBMITTALS

- 1.4.1. Contractor shall provide Owner and / or CxA with documentation required for Commissioning Work. At minimum, documentation shall include: Detailed Start-up procedures, full sequences of operation, Operating and Maintenance data, performance data, control drawings, and details of Owner-contracted tests.
 - 1.4.1.1. Shop drawings and product submittal data related to systems or equipment to be commissioned.
- 1.4.2. Contractor shall submit to Owner and / or CxA installation and checkout materials actually shipped inside equipment and actual field checkout sheet forms used by factory or field technicians.
- 1.4.3. Where installation testing may be performed in a progressive manner (i.e. grounding systems, insulation resistance, etc.), the Contractor shall prepare and submit to the Owner, A/E team and CxA a testing plan that details how the progressive testing will be

ELECTRICAL AND LIFE SAFETY SYSTEMS TECHNICAL COMMISSIONING REQUIREMENTS

performed, documented and presented for approval prior to the start of any testing activities.

- 1.4.4. Contractor shall provide Owner with documentation required for Commissioning work. At minimum, documentation shall include: Detailed Start-up procedures, Full sequences of operation, Operating and Maintenance data, Performance data, Functional Performance Test Procedures, Control Drawings, and details of Owner-Contracted tests.
- 1.4.5. Contractor shall provide any additional documentation needed to complete the requirements of the Commissioning Process
 - 1.4.5.1. Factory Performance Test Reports: Review and compile all factory performance data to assure that the data is complete prior to executing the FPTs.
 - 1.4.5.2. Incorporate manufacturer's initial energizing / startup procedures with System Verification Checklists.
 - 1.4.5.3. Final Electrical Testing Agency (ETA) Reports documenting all NETA requirements indicated in the Project Documents
 - 1.4.5.4. Completed equipment Start-up certification forms along with the manufacturer's field or factory performance and Start-up test documentation.
 - 1.4.5.5. Operating and Maintenance (O&M) information per the requirements of the Technical Specifications and Division 01 requirements.

PART 2 - PRODUCTS

2.1. GENERAL

- 2.1.1. All materials and installation shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.
- 2.1.2. Refer to the General Commissioning Requirements for other work products related to the Commissioning Process
- 2.1.3. Contractor is required to follow all applicable industry and site specific safety practices, lockout / tagout requirements, specialized PPE requirements, and provide qualified, trained personnel to execute Commissioning Process requirements.

2.2. TEST EQUIPMENT

- 2.2.1. The Contractor shall provide all specialized tools, test equipment and instruments required to execute Start-up, checkout, and testing of equipment.
- 2.2.2. All specialized tools, test equipment, and instruments required to execute Start-up, checkout, and testing of equipment shall be of sufficient quality and accuracy to test and/or measure system performance within specified tolerances. A testing laboratory must have calibrated test equipment within the previous twelve (12) months. Calibration shall be NIST traceable. Contractor must calibrate test equipment and instruments according to manufacturer's recommended intervals and whenever the test equipment is dropped or damaged. Calibration tags must be affixed to the test equipment or certificates readily available.

PART 3 - EXECUTION

3.1. CONSTRUCTION PHASE

- 3.1.1. In each purchase order or subcontract that is written for changes in scope, include the appropriate requirements for submittal data, Commissioning documentation, testing assistance, Operating and Maintenance (O&M) data, and training, as a minimum.
- 3.1.2. Attend Pre-Commissioning Meeting(s), Pre-Installation Meeting(s), and other Project meetings scheduled by the Owner, CxA or Contractor to facilitate the Commissioning process.
- 3.1.3. Provide manufacturer's data sheets and shop drawing submittals of equipment.
- 3.1.4. Provide additional requested documentation to the Owner and / or CxA, prior to O&M manual submittals, for development of System Verification Checklists and Functional Performance Testing procedures.
 - 3.1.4.1. Typically, this will include detailed manufacturer's installation and Start-up, operating, troubleshooting and maintenance procedures, full details of any Owner-contracted tests, full factory testing reports, if any, and full warranty information.
 - 3.1.4.2. In addition, the installation, Start-up, and checkout materials that are actually shipped inside the equipment and the actual field checkout sheet forms to be used by the factory or field technicians shall be submitted to the Contractor and / or CxA.

This information and data request may be made prior to normal submittals.

- 3.1.5. With input from the Lighting Controls, PCMS vendors and A/E, clarify the operation and control of commissioned equipment in areas where the Specifications, control drawings, or equipment documentation are not sufficient for writing detailed test procedures.
- 3.1.6. During the installation, Start-up and initial checkout process, execute and document related portions of the System Verification Checklists for all commissioned equipment according to the procedures indicated in the Commissioning Plan.
- 3.1.7. Factory Start-ups: Factory Start-ups are specified for certain equipment. Factory Start-ups generally are Start-up related activities that will be reviewed and checked prior to Functional Performance Tests. All costs associated with factory Start-ups shall be included with the contract price unless otherwise noted. Notify the Commissioning Team of the factory Start-up schedule and coordinate these factory Start-ups with witnessing parties. The Commissioning Team members may witness these Start-ups at their discretion.
- 3.1.8. Independent Testing Agencies: For systems that specify testing by an independent testing agency, the cost of the test shall be included in the Contract price unless otherwise noted. Testing performed by independent agencies may cover aspects required in the System Verification Checklists, Start-ups, and Functional Performance Tests. Coordinate with the independent testing agency so that CxA, Owner and/or A/E can witness the test to ensure that applicable aspects of the test meet requirements.
- 3.1.9. Provide skilled technicians to execute starting of equipment and to assist in execution of Functional Performance Tests. Ensure that they are available and present during the

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agreed-upon schedules and for a sufficient duration to complete the necessary tests, adjustments, and problem solving.

3.1.10. Correct deficiencies (differences between specified and observed performance) as interpreted by the Owner's Project Manager and A/E and retest the system and equipment.

3.1.11. During construction, maintain as-built marked-up Drawings and Specifications of all Contract Documents and Contractor-generated coordination Drawings. Update after completion of Commissioning activities (include deferred tests).

3.1.12. Provide training of the Owner's operating personnel as specified.

3.1.13. Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.

3.2. WARRANTY PHASE

3.2.1. Execute seasonal or deferred tests, witnessed by the CxA and Owner, according to the Specifications.

3.2.1.1. Complete deferred tests as part of this Contract during the Warranty Period. Schedule this activity with the Owner.

3.2.2. Correct deficiencies and make necessary adjustments to O&M manuals, Commissioning documentation, and as-built drawings for applicable issues identified in any deferred or seasonal testing.

3.3. INSTALLATION

3.3.1. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

3.3.2. All installation shall be in accordance with the Project Documents.

3.4. TRAINING

3.4.1. Refer to the individual section of this Specification for specific training requirements on each system.

3.4.1.1. Refer to the General Commissioning Requirements and Division 01 of the Project Specifications for overall training requirements related to the Commissioning process and this project.

**SECTION 26 09 22 - MODIFICATION OF EXISTING MOTOR
CONTROL CENTERS**

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Motor control center work is as required, scheduled, and as specified.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Match existing manufacturer or OEM approved third party replacement parts and materials.

2.2 MATERIALS AND COMPONENTS

- A. General: Except as otherwise indicated, provide motor control center manufacturer's standard materials and components as indicated by published product information, designed and constructed as recommended by the manufacturer, and as required for a complete installation.

2.3 600 VOLT MOTOR CONTROL CENTERS

- A. Provide a factory-assembled, dead-front construction, metal-enclosed, self-supporting motor controllers of the voltage, phase, ampacity, and short circuit bracing required.
1. Motor controllers shall include starters, protective devices, and equipment as required with interconnections, instrumentation, and control wiring. Small wiring, fuse blocks, and terminal blocks within the motor control center shall be included within the motor control center. Groups of control wires leaving the motor control center shall be furnished with terminal blocks with suitable numbering strips. Wiring shall be NEMA Class I, Type B, unless shown otherwise.
 2. Provide a phase power monitor for each new motor controller unless the existing motor control center has a centrally located monitor. Monitor relay shall drop out upon loss of any phase, undervoltage on any or all phases, or phase reversal from A-B-C sequence. Relay shall be adjustable for trip range and shall reset automatically when phase voltage and sequence is corrected. All motor starters shall open when monitor relay drops out, and automatically reset.
- B. Motor Control Devices: Each motor control device shall be a combination motor control unit consisting of a magnetic starter in combination with a circuit breaker. Each unit shall be rated as shown, and as required by equipment served.
1. Provide full-voltage, non-reversing, single-speed (FVNR), full-voltage, non-reversing, two-speed, two-winding (2S-2W), and reduced-voltage, non-reversing auto-transformer-type, closed transition (RVNR) starters sized as required. Starters shall be constructed and tested in accordance with the latest NEMA standards.
 2. Provide circuit breakers as specified below.
 3. Magnetic starter contacts shall be solid silver alloy, and shall not require filing, dressing, or cleaning throughout the life of the starter.
 4. Operating coils shall be 120V, and shall be pressure molded, and designed so that accidental exposure to excessive voltage up to 480V will not damage the coil. The starter shall also be designed so that when a coil fails due to an overvoltage condition, the starter shall definitely open, and shall not freeze in the closed position.

5. Starters shall have manual reset, solid state, trip-free overload relays in each phase conductor. 3 phase FVNR starters shall have three overload relays. Single-phase FVNR starter shall have an overload relay in each ungrounded conductor. Two speed, full-voltage magnetic starters shall have overload relays for all 6 control legs. Overload relays shall not be field-convertible from manual to automatic reset. Provide button in front cover to reset all overload relays.
 6. Starters shall have 30.5mm RUN and STOP LED pilot lights. Furnish additional pilot lights for motor starters as shown. Provide FAST and SLOW pilot lights for two-starters. Pilot lights shall be mounted in the starter enclosure cover. Pilot lights shall be operated from an interlock on the motor starter, and shall not be wired across the operating coil.
Green – Stop
Red - Run
Yellow - Slow
Blue - Fast
 7. Starters shall have 30.5mm HAND-OFF-AUTOMATIC switches. Provide for FAST-SLOW, REMOTE-LOCAL speed selection from HVAC control system for two-speed starters. Two-speed starters shall have deceleration relays between fast and slow speeds. Coordinate motor starter controls with the requirements of Division 23. Motor starter controls shall be mounted in the starter enclosure cover.
 8. Each motor starter shall have two normally open and two normally closed nonconvertible auxiliary contact in addition to the number of contacts required for the "holding interlock" and control wiring. In addition, it shall be possible to field install one or more additional auxiliary contacts without removing existing wiring, or removing the starter from the enclosure.
 9. Make provision for the units to be removed from the vertical bus without disturbing the wiring of the individual motor starter unit and permit starter door to be closed and fastened when removed. Include means to prevent incorrect operation of the stab-in mechanism. Each individual removable unit shall be held in place with a positive-acting center toggle mechanism. Motor starter units up through NEMA Size 4 shall be provided with the stab-in mechanism.
- C. Integrated Equipment Rating: Each motor controller, as a unit, shall be given an integrated equipment rating by the manufacturer to match the existing rating of the existing motor control center. The integrated equipment short-circuit rating shall certify that equipment is capable of withstanding the stresses of a fault available at the motor control center. The ratings shall have been established from tests by the manufacturer on similar equipment as the motor control center. This test data shall be available and submitted, if requested, with or before the submittal of shop drawings.
- D. Molded case circuit breakers:
1. Greater than 800 Amp: Solid state true RMS sensing with adjustable: current, I²t settings, ground fault (where required), instantaneous trip, and short time trip; 80-percent continuous current rating.
 2. 800 Amp and smaller: Solid state true RMS sensing with fixed current setting by rating plug or dial. Breaker shall have adjustable instantaneous trip function with short time tracking.
 3. 1,200 Amp and larger frame circuit breakers regardless of trip shall have Energy Reducing Maintenance System switch with local status indicator (ERMS).
- E. Fusible switches:
1. Quick-make, quick-break units utilizing the double-break principle of circuit interrupting to minimize arcing and pitting and shall conform to the ratings shown.
 2. Individual door over the front, equipped with a voidable interlock that prevents the

door from being opened when the switch is in the ON position unless the interlock is purposely defeated by activation of the voiding mechanism. All switches shall have externally operated handles.

3. 600 Amps and below equipped for Class J fuses.
4. 601 Amps and above shall be equipped for Class R or L fuses.
5. When required by the latest edition of the NEC or the AHJ, 1,200 Amp fused switches regardless of fuse size installed shall have Energy Reducing Maintenance System switch with local status indicator (ERMS).

PART 3 - EXECUTION

3.1 INSTALLATION OF MOTOR CONTROL CENTERS

- A. General: Install motor controllers where shown, or as required, in accordance with the manufacturer's written instructions and industry practices to ensure that the motor controller comply with the specified requirements.
- B. Standards: Comply with requirements of NEMA and NEC standards, and NECA Standard of Installation, for installation of motor control centers.
- C. Tightness: Torque bus connections and tighten mechanical fasteners.
- D. Fuses: Install fuses, of the ratings shown, in each motor starter.
- E. Overloads: Install overload relays with manual reset in each phase of motor controller. Overload adjustable settings shall be based on actual motor nameplate full load amps. Field verify nameplate full load amps and adjust all relay settings accordingly.
 1. Set overcurrent at motor service factor x motor nameplate FLA
 2. Set high voltage trip to 8.3 percent above nominal voltage
 3. Set undercurrent trip to four automatic restarts
 4. Set all other trips to zero auto restarts
 5. Phase Failure Relay: Adjust phase failure relay to 10 percent over voltage and 10 percent under voltage.
- F. Supports: Provide individual and combination motor controllers with galvanized angle or other suitable supports if mounting on wall or other rigid surface is impractical. Controllers shall not be supported by conduit alone. Where motor controllers are mounted on equipment served, the switch shall not inhibit removal of any service panels or interfere with any required access areas. Manual motor controllers shall be installed plumb and aligned in the plane of the wall where they are installed.
- G. Where motor controllers are indicated to be installed as part of a Motor Control Center, refer to the Motor Control Center specification.
- H. Adjustment: Adjust operating mechanisms for free mechanical movement.
- I. Coordination: Motor starter supplier shall coordinate with motors furnished by Division 23. Motor starter supplier shall coordinate with the Building Management Control System, Division 23.
- J. Identity each motor controller or branch circuit protective device as specified in Section 26 05 00.

3.2 TESTING

- A. Provide the field services of the manufacturer to provide initial programming of all variable functions, start-up and commissioning of each motor controller.
- B. Pre-Energization Check: Check motor controllers for continuous circuits and short circuits.
- C. Post Hook-Up Test: After wire and cable hook-ups, energize motor controller to show it functions as specified.

END OF SECTION

SECTION 26 09 28 - DIGITAL LIGHTING CONTROLS – CY-FAIR ISD

PART 1 - GENERAL

1.1 INTRODUCTION

- A. The work covered in this section is subject to all of the requirements in the General Conditions of the Specifications. Contractor shall coordinate all of the work in this section with all of the trades covered in other sections of the specification to provide a complete and operable system.
- B. Contractor shall provide to the digital lighting control equipment manufacturer all quantities for system including but not limited to room controllers, occupancy sensors, button stations, photocells, emergency lighting controllers, and wire lengths for room controller communications bus.
- C. Contractor shall demonstrate to the Owner, the complete successful operation of system including but not limited emergency lighting operation. Demonstration shall occur a minimum of 30 days prior to the contract schedule completion date. Installing electrical contractor shall replace any failed material during warranty period of one year at no additional cost to the Owner.
- D. Refer to the drawings and other specifications in Division 23 and 26 regarding lighting controls for exterior lighting and other interior areas indicated for control by the Building Management Control System (BMCS) or other means other than the digital lighting controls specified in this section.
- E. Factory startup and commissioning for substantial completion, 90-day verification re-commissioning, and 11-month close-out commissioning shall be provided.

1.2 QUALITY ASSURANCE

- A. Component Pre-testing: All components and assemblies are to be factory pre-tested and burned-in prior to installation.
- B. NEC Compliance: Comply to NEC as applicable to electrical wiring work.
- C. NEMA Compliance: Comply with applicable portions of NEMA standards pertaining to types of electrical equipment and enclosures.

1.3 SYSTEM DESCRIPTION & OPERATION

- A. The lighting control system as defined under this section covers the following equipment for local room or local area networks only. Building wide network equipment is not required and shall not be provided unless those capabilities are inherent to the base components required or specified for local room controls only.
 - 1. Digital Room Controllers – Self-configuring, digitally addressable relay controllers with 0-10-volt dimming control for lighting and single relay application-specific plug load controllers when plug load control is specified or required.
 - 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 – If Code required, single-zone closed loop and multi-zone

open loop daylighting sensors with two-way active infrared (IR) communications that 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.
 6. 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.
 7. DLM Lighting control system components shall have the capability to be easily expanded in the future to a building wide network functionally using all of the following topologies: a fully wired network.
- B. Lighting controls and automation for exterior lighting and interior areas not controlled by the system specified in this section shall be as required and as specified by other specification sections in Division 23, and 26.
- C. Power and communications for lighting controls provided shall be wired. Use of batteries or wireless communications is prohibited. Dimming control wiring shall not be installed with any line voltage power wiring conduits.

1.4 SUBMITTALS

- A. Submit the specification line-by-line compliance review, shop drawings, and the product data specified below under one cover as a complete submittal.
1. Specification compliance review: refer to Electrical Shop Drawings specification section for instructions and additional information.
 2. Shop Drawings:
 - a. Composite wiring and/or schematic diagram of each control circuit as proposed to be installed (standard diagrams will not be accepted).
 - b. Scale drawing for each area showing the exact location of each sensor, room controller, and digital switch.
 3. Product Data: Catalog sheets, specifications and installation instructions.
 - a. Include data for each device which:
 - b. Indicates where sensor is proposed to be installed.
 - c. Prove that the sensor is suitable for the proposed application.

1.5 WARRANTY

- A. Wattstopper Digital Lighting Management (DLM) control products: Provide a five-year complete manufacturer's warranty on all products to be free of manufacturers' defects.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. WattStopper (Legrand North America, LLC)
1. System: Digital Lighting Management (DLM). No Substitutions.

2.2 DIGITAL WALL OR CEILING MOUNTED OCCUPANCY SENSOR SYSTEM

- A. Ceiling mounted (or where specifically indicated or required to be wall mounted to suit installation); passive infrared (PIR), ultrasonic, or dual technology (passive infrared and ultrasonic) digital occupancy sensor. Furnish the 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.

- 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 shall be required.
- E. WattStopper product numbers: LMPX, LMDX, LMPC, LMUC, LMDC, LMDW

2.3 DIGITAL WALL SWITCHES

- A. Low voltage momentary pushbutton switches in 1, 2, 3, 4, 5 and 8 button configurations; grey, compatible with building standard stainless-steel 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 dependent; each button may be bound to multiple loads.
- E. WattStopper product numbers: LMSW-101, LMSW-102, LMSW-103, LMSW-104, LMSW-105, LMSW-108, LMDM-101.

2.4 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 shall be simple to install and shall not have dip switches, potentiometers or require special configuration. The control units shall 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
 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 configurations
 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 LED drivers.
 6. 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
 7. Discrete model listed for connection to receptacles, for occupancy-based control of plug loads within the space.
 - a. One relay configuration only

- b. Automatic-ON/OFF configuration
- 8. WattStopper product numbers: LMRC-211, LRMC-212, LRMC-213, LMPL-201,

2.5 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 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.

2.6 ROOM OR AREA NETWORK

- A. The DLM local network shall be a free topology lighting control physical connection and communication protocol. Digital room devices connect to the network using CAT 5e cables with RJ-45 connectors which provide both data and power to room devices. The DLM local network shall 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.

2.7 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 the 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

2.8 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/Dimming control of emergency lighting along with the normal lighting. Upon normal power failure the emergency lighting circuit will close, forcing the emergency lighting to be fully bright ON until normal power is restored. Features include:
 - 1. 120/277 volts, 50/60 Hz., 20-amp driver rating
 - 2. Push to test button

3. Auxiliary contact for remote test or fire alarm system interface.
- B. WattStopper Product Numbers: ELCU-200.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION:

- A. Install the work of this Section in accordance with manufacturer's printed instructions unless otherwise indicated. Provide a minimum of eight hours of on-site technical support for the coordination between the BMCS and the Wattstopper lighting controls. Ensure that the sequences of operation involving the BMCS are fully operational as specified and as required.
- B. The installing contractor shall, prior to request of WattStopper factory start up and site commissioning, request an on-site meeting by including local factory representative, Owner and the general contractor, to assist in identification of any open-ended issues, thereby eliminating potential for delays and system commission interruptions.
- C. Upon confirmation of progress by local factory authorities, the installation electrical contractor shall complete the start-up request form found in the WattStopper submittals, including any field changes from the contract documents. This is essential to facilitate substantial completion.
- D. Room controllers shall be installed so that they are easily accessible for replacement or maintenance:
 1. Mount lighting control equipment to junction boxes as recommended by the manufacturer.
 2. Where accessible ceiling heights are 10-feet AFF or less, room controllers shall be mounted on wall above local control switch location between 4 and 18-inches above the accessible ceiling and 2-inches clear of T-grid for above ceiling access.
 3. Where ceiling heights are above 10-feet, room controllers shall be mounted in an ancillary area above the ancillary area local control switch location with accessible ceiling of 10-feet or less. The high ceiling room controller shall be mounted adjacent to the lower ceiling room controller serving the ancillary area. The room controller for the high ceiling and ancillary area(s) may utilize the same room controller for each area if practical. If an ancillary area with low accessible ceiling area is not available, the room controller shall be installed in the same mechanical or electrical room as the electrical panel serving the lighting for that area and clearly labeled for its use and specific room that it controls.
 4. Smaller ancillary spaces not separated by doors that adjoin the larger space do not require an additional control zone and shall be controlled with the larger adjoining space zone to reduce complexity.
- E. Lighting controls shall meet the minimum requirements of all local codes in effect when the project will be permitted with whatever exceptions deemed appropriate by the Owner. Wherever possible, minimize the complexity of the controls design to reduce the quantity and types of required sensor hardware, low voltage and line voltage wiring:
 1. Provide UL 924 emergency load control devices so that designated emergency interior light fixtures will be controlled ON/OFF/dimmed with adjacent area lighting and be brought to full-bright ON during power failure.
 2. Provide full floor area occupancy/vacancy sensor coverage wherever sensors are required.
 3. Provide 20-minute time out delay where vacancy sensor control is provided or required.

4. Provide 20-minute or IECC maximum time out delay, whichever is shortest, where occupancy sensor control is provided or required.
- F. Where daylighting controls are required or indicated they shall be fully automatic and full range dimming without local user overriding of the daylighting maximum light level set point or trim level. Local user override to dim to OFF shall be provided. A single photo sensor shall be interfaced with the room controller for each daylighting zone in an area and for each cardinal direction as required by the IECC, and as recommended by the lighting control system vendor.
- G. Low voltage cabling installed above ceiling shall be supported every 5 feet at a minimum height of 3 feet above grid/ceiling but no closer than six inches below deck. Support system shall be ceiling wire attached to structure and clipped to ceiling support grid using Caddy drop wire securing clip #EC311. Cabling shall hang plumb to devices. Low voltage control wiring shall not be installed in the same raceway with line voltage wiring.
- H. Renovation areas: Utilize existing wall box switch locations where line voltage wiring is removed and therefore can be utilized for low voltage control controls and control cabling unless shown or noted otherwise.

3.2 GENERAL SEQUENCES OF OPERATION

- A. Refer to plan and plan details for additional information for specific areas and additional requirements. Where plans or plan details are in conflict with these specifications, provide the more stringent of the two, however verify with the Owner/Architect for clarification for the exact requirements to be provided prior to construction at no additional cost to the Owner.
- B. Areas with lighting that requires dimming: Manual ON shall initially bring the lighting level to lighting control system 80-percent set point but not lower than the minimal CFISD design standard-maintained foot-candela light level for the type of space served. Refer to CFISD's Electrical-Light Fixture standards for required maintained light levels. Contractor/vendor shall verify in the field with CFISD during the commissioning process typical acceptable light levels with all ceilings and walls installed and with final paint and finishes applied. It is CFISD's intention to adjust the trim points to a minimally acceptable light level and only adjust as needed due to light fixture lumen depreciation over the lifetime of the light fixtures. This will increase energy savings and extend the lifetime of the lighting system.

3.3 SEQUENCES OF OPERATION FOR SPECIFIC AREAS – REFER TO PLAN DETAILS FOR ADDITIONAL PROJECT SPECIFIC INFORMATION AND INSTRUCTIONS

- A. **CORRIDORS, STUDENT AND PUBLIC TOILETS/RESTROOMS ACCESSIBLE DIRECTLY FROM CORRIDORS, AND STAIRS:** Includes all hallways and other egress pathways, including attached open access without doors, ancillary spaces such as flex or collaboration spaces, student and public toilets/restrooms with or without a door open to corridor, (This does not include large areas open to the corridor pathway such as the adjoining seating areas of cafeteria, dining, commons, nor shall it include administrative staff toilets or restrooms).
 1. Control through BMCS. BMCS occupied (turn ON) or unoccupied (turn OFF) state sent to DLM room controllers. Single DLM occupancy sensor and Hubbell key switch at each security keypad. Sensor to be used for auto ON only; sensor shall not turn corridor lights OFF. Dimming only if required for code required daylight harvesting.
 2. Provide DLM occupancy sensor for body movement detection in corridors

(maximum spacing 50-feet) to only turn all corridor lights ON. Provide hand motion sensor coverage in adjoining toilets/restrooms. Provide a DLM Hubbell momentary SPDT key switch next to each security keypad to manually turn corridor lights ON only (to be used if there is a DLM sensor failure or BMCS failure or if BMCS is in un-occupied state). Key switch shall not turn lights OFF. Any corridor occupancy sensor shall trigger all corridor DLM room controllers to turn lights ON at any time of day and will remain ON until a BMCS unoccupied state in which the lights shall turn OFF.

3. Corridors and their attached open access ancillary general use spaces and attached student/public toilets with or without corridor doors shall be grouped together. Do not switch general use ancillary spaces including student/public toilets with or without doors separately from the corridor that have direct access from an adjoining corridor.
 4. Flex or collaboration spaces open to corridors shall be a separate dimming control zone but shall be grouped with the adjoining corridor's occupancy sensors and BMCS control for BMCS ON/OFF and sensor ON.
 4. Corridor Hubbell SPDT key switch shall be located at each security system control keypad and shall have both load terminals shunted so that either up or down position will turn the lights ON. Label key switches as "CORRIDOR LTG ON".
 5. Do not provide a fire alarm interface since sensors do not turn lights OFF.
 6. DLM locations and quantities shall be kept to a minimum. Multiple corridors shall be grouped and controlled together as much as practical. Individual corridors do not require individual local controls. All corridors are either all on or all off.
 7. Lighted display cases in corridors: Circuit with corridor lighting and with additional local manual line voltage key switch required by IECC identified as "CASE LTG".
 8. Provide separate local switching or dimming for open ancillary flex spaces only if indicated.
 9. No light switches in enclosed stairs. Switch and control all stair floor landings with the first-floor corridor except that one or more light fixture at each floor landing shall be controlled with that respective floor's corridor lighting. Do not provide sensors in stairs. Un-enclosed stairs shall be considered an extension of the adjoining corridor or space and shall share the adjoining corridor or space-controlled lighting line voltage circuits/zone. Do not provide a separate zone for un-enclosed stairs open to adjoining spaces.
- B. INSTRUCTION AND ADMINISTRATIVE AREAS, OFFICES, LOUNGES/BREAK ROOMS, COPY/PRINT ROOMS, AND SIMILAR AREAS, STORAGE ROOMS THAT ARE 100 SQUARE FEET AND LARGER.
1. SEQUENCE: Provide vacancy sensor control (DLM system manual ON/OFF, auto OFF, DIM).
 2. Instructional areas, classrooms, and large group instruction up to 99-person occupancy provide single zone dimming with DLM control at each entry door. Provide additional zones if the room is equipped with room divider partitions.
 3. Large Group Instruction over 100-person occupancy: Provide up to three dimming zones, one over the presentation display area, one over the seating area, and one for any other specialty lighting or enhanced zone functionality. Provide DLM system master control station only at the main entry door or near the presentation area. Provide entry station(s) at each entry door to provide ON/OFF general lighting.
- C. SHOPS, KITCHEN, FOOD SERVING QUEUE, AND NATATORIUM
1. BMCS to interface with DLM room controllers for occupied/un-occupied state. Un-occupied state shall turn lights off. No occupant sensors for safety and security. Local DLM switches also function as a local override. No dimming
 2. Kitchen/serving: Manual local DLM switches. Locate kitchen/serving switches in

supervised locations for on/off control. Occupancy sensor for auto ON only, sensor shall not turn kitchen/serving lights OFF. No dimming (health code lighting requirement supersedes IECC).

3. Shops: Provide lighting with less than 0.6-Watts per square foot for IECC exception to not require lighting reduction controls or dimming. Occupancy sensor for auto ON only, sensor shall not turn shop lights OFF. No dimming.
4. Natatorium: Safety and security: BMCS unoccupied state shall turn lights OFF. No automatic sensor lighting controls, no dimming, no light reduction controls. ON/OFF with Hubbell key switches located at main entry/exit door and as directed by CFISD. Provide manual DLM switch for ON/OFF control in swimming coaches' office or other supervised location as directed by CFISD. The DLM room controller for the natatorium shall be located above an accessible low height ceiling, preferably next to the coaches' office DLM room controller, or as directed by CFISD.

D. CAFETERIA, CAFETORIUM, GYMS, LIBRARY, STAGE, LOCKER ROOMS

1. BMCS to interface with DLM room controllers for occupied/un-occupied state. Un-occupied state shall turn lights OFF. No occupant sensors for safety and security. Local DLM switches also function as a local DLM override. Dimming only as required for light reduction, code required daylight harvesting, and as indicated on drawings.
2. Cafeterias and cafetorium's: DLM Hubbell SPDT key switches at cafetorium main entry. Dimming switches at main entry and on stage. Cafeterias require only one dimming zone. Cafetorium with stage: Provide up to three dimming zones, zoned from front of house to back of house.
3. School stage general lighting: General lighting for stages and platforms with proscenium curtains or wall dividers shall be controlled as a separate zone. Provide a separate zone for back-of-house stage access ramps. Provide DLM ON/OFF control for the stage general lighting at each entry/exit point to the stage. Provide ramp lighting ON/OFF DLM control at each end of the ramp. Verify zoning and switch locations with theatrical consultant drawings.
4. Elementary School Cafetorium Theatrical Track Lighting: Locate four ganged wall box 120-volt line voltage dimmer controls on stage at an accessible location, not obstructed by stage curtains, as indicated or as directed by CFISD.
5. Library: Manual DLM control located in supervised area (behind circulation desk or as directed by CFISD). Hubbell SPDT key switch at main entry door location as directed by CFISD. If dimming zones are provided locate dimming controls in a secured area (circulation desk). Key switch ON function shall force all lights to full bright.
6. Gyms: Manual DLM Hubbell SPDT key switch. Provide separate zones with Hubbell key switch to enable UIL competition light level for UIL Sports Lighting Standards. Label key switch for UIL competition light level control as court as "UIL COMPETITION ONLY".
7. Locker rooms: Occupancy sensors control for auto ON/OFF: Set sensors to full-bright on and 20-minute time delay off for safety and security. Manual ON/OFF with DLM Hubbell momentary SPDT key switches located at main entry doors and as directed by CFISD. Provide lighting in these areas with less than 0.6-Watts per square foot for IECC exception to not require lighting reduction controls.

E. CLOSED-DOOR ADMINISTRATIVE OR PRIVATE TOILETS/RESTROOMS, DRESSING ROOMS, OTHER TOILETS/RESTROOMS WITH DOORS NOT DIRECTLY CONNECTED TO A CORRIDOR:

1. SEQUENCE: Occupancy sensors (DLM system manual ON/OFF, automatic ON/OFF).
2. Provide dual technology occupancy sensor control for automatic ON/OFF based

on occupancy. Set occupancy time delay and sensitivity to device setting maximum for safety and security.

3. Student/public restrooms with doors not connected to an adjacent egress corridor: Provide CFSID standard Hubbell momentary key switch at student and public toilets/restrooms entry door location for manual DLM ON/OFF.
 4. Private or administrative toilets/restrooms: Provide standard DLM ON/OFF switch for all other restrooms and dressing rooms with doors.
- F. MECHANICAL, ELECTRICAL, PLUMBING, ELEVATOR, AND TECHNOLOGY ROOMS
1. Provide line voltage mechanical time switch withhold at each entry door, wired in parallel as required. Refer to Line Voltage Wiring Device specifications.
- G. CUSTODIAL, JANITORIAL, STORAGE LESS THAN 100SF, UTILITY ROOMS, FREE STANDING REMOTE BUILDINGS (CONCESSION, PRESS BOX, TICKETING, ETC.)
1. DLM vacancy sensor, no dimming except for press box viewing space.
- H. BLACK BOX THEATRES
1. Black box theatres shall be provided with standalone instructional lighting, lighting controls and emergency lighting typical of instructional areas and classrooms.

3.4 IDENTIFICATION FOR LIGHTING CONTROL SYSTEM EQUIPMENT

- A. Above ceiling lighting control system equipment locators: Provide plastic tape machine typed name plate to bottom of ceiling T-grid below relay location. White letters on black background with ¼" high letters on ½" tall label for digital lighting module indicate as: DLM.
- B. Room controller identification: Label each digital room controller with 120/277 Volt circuit (i.e., "HD-27") and room graphic name and number. Do not use architectural room name or number on drawings, use room graphic identification only.
- C. All low voltage wiring shall have "WattStopper" printed on the wire jacket.

3.5 ATTIC STOCK

- A. Provide a minimum of 2 or 5 percent of the project total, whichever is greater, of all other hardware components used.
- B. Provide five configuration handheld remote tools for new facilities or three remote configuration handheld remote tools for renovation facilities.

3.6 FACTORY COMMISSIONING

- A. The installing electrical contractor shall complete, prior to request of WattStopper factory start up and site commissioning, complete installation of all devices, their respective loads landed and confirmed operations, switches installed and confirmed operation of each and every local room network. 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 installing electrical contractor shall provide a preliminary as-built drawing prior to commissioning. Drawing shall include room by room device ID's and locations of all WattStopper devices.
- C. The factory commissioning shall include the following services. Programming of all button

stations, configuration of all occupancy sensors and photocells. Verification of a complete working system.

- D. 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.)
- E. The electrical contractor shall provide in writing, both the manufacturer and Owner, with 21-Owner business days written notice of the requested system startup and adjustment date.
- F. 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.
- G. 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.
- H. Re-commissioning – After 90 days from occupancy 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.
- I. Close-out commissioning - After 11-months from substantial completion, re-calibrate sensor time delays and sensitivities to Owner's Satisfaction at no additional cost to the Owner. Provide a detailed report to the Architect / Owner of re-commissioning activity.

END OF SECTION

SECTION 26 12 17 - ULTRA HIGH EFFICIENCY K-RATED TRANSFORMERS

PART 1 – GENERAL

1.1 WORK INCLUDED

- A. Copper-wound three-phase transformer exceeding US Department of Energy 2016 Efficiency Standards, with extremely low no load losses.
 - 1. Transformers shall be designed to an efficiency standard higher than NEMA Premium.
- B. Load Mix: Transformer shall be UL 1561 Listed to feed a mix of equipment load profiles such as computers without derating or significant degradation of efficiency.

1.2 REFERENCES

- A. FEDERAL REGISTER – US Department of Energy, Office of Energy Efficiency and Renewable Energy. 10 CFR Part 431. Energy Conservation Program for Commercial and Industrial Equipment: Energy Conservation Standards for Distribution Transformers; 2016 Standards
- B. DOE Test Method For Measuring The Energy Consumption Of Distribution Transformers Under Appendix A To Subpart K Of 10 CFR Part 431.
- C. Metering Standards:
 - 1. Computational algorithms per IEEE Std 1459-2000
 - 2. UL 916, UL 61010C-1 CAT III
- D. IEEE-1100 – Recommended Practice for Powering and Grounding Sensitive Electronic Equipment
 - 1. IEEE Standard 1100 documents how typical transformers feeding electronic equipment produce substantially higher losses under electronic equipment load compared to under linear load, requiring derating.
- E. LEED – Leadership in Energy and Environmental Design, U.S. Green Building Council.
- F. ISO 9000:2000 – International Standards Organization - Quality Management System
- G. ISO 14000:2004 – International Standards Organization - Environmental Management System
- H. NFPA 70 - National Electrical Code (Latest Edition)
- I. NEMA ST20-2014 - Dry-Type Transformers for General Applications
- J. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment
- K. US Department of Energy, 10 CFR Part 431, 2015. Energy Conservation Program: Energy Conservation Standards for Distribution Transformers; Final Rule.
- L. IEEE C57.110-2008 – IEEE Recommended Practice for establishing transformer capability when feeding non-sinusoidal load currents.

- M. ISO 17025 – International Standards Organization - General requirements for the competence of testing and calibration laboratories.
- N. UL 1561 - Dry-Type General Purpose and Power Transformers.

1.3 SUBMITTALS

- A. Submit product data including the following:
 - 1. Copy of ISO 14001:2004 Certification of manufacturing operation.
 - 2. Copy of ISO 9001:2000 Certification of manufacturing operation.
 - 3. Construction Details including enclosure dimensions, kVA rating, primary & secondary nominal voltages, voltage taps, BIL, unit weight
 - 4. Basic Performance characteristics including insulation class, temperature rise, core and coil materials, impedances & audible noise level, unit weight
 - 5. Inrush Current (typical 3 cycle recovery)
 - 6. Short Circuit Current data: Primary (Sym. O/P S/C) & Secondary (L-N/G S/C)
 - 7. Efficiency Data
 - a. No load and full load losses per NEMA ST20
 - b. Linear load Efficiency data @ 1/6 load
 - c. Linear load efficiency data @ 1/4, 1/2, 3/4 & full load
 - d. Linear Load Efficiency @ 35% loading tested per NEMA TP-2.
 - e. Efficiency under specified K rating load profile at 15%, 25%, 50%, 75%, 100% of nameplate rating.
 - 8. Copy of Factory ISO 9001 documentation describing nonlinear load test program
 - a. Meter and CT details including model, accuracy, serial numbers and calibration information.
 - 9. Copy of Linear & Nonlinear load test report for a representative 75kVA transformer
 - 10. 25 year Product Warranty Certificate
- B. Description of manufacturer's factory nonlinear load test program.
 - 1. In light of the significant degradation of transformer performance when feeding nonlinear load compared to linear load, it is mandatory that the manufacturer test the transformers under nonlinear load representative of real world load mix. Transformers that have not been subject to testing under nonlinear load will not be considered for this project due to the uncertainty related to their real world performance.
 - 2. Given the lack of a standard for testing transformers under nonlinear load, the manufacturer must have a nonlinear Load Test Program operating in the production environment that is audited and documented per quality standard ISO 9001.
 - 3. The nonlinear load bank shall consist of a phase-neutral loading with a specified K rating load profile, representative of a mix of typical commercial equipment.
 - 4. Meters and CTs shall both be revenue class accurate. CTs shall be operated within their approved accuracy loading range. Dual meters shall gather simultaneous primary and secondary energy and harmonic data. Meter and CT details including model, accuracy, serial numbers and calibration information.
 - 5. Efficiency: Measurements shall be taken at multiple load levels and plotted to show compliance with specification and correlation to the designed efficiency curve.
 - 6. Efficiency shall be determined purely by measurements using method and instrumentation per NEMA TP-2 Standard. Other methods are not acceptable.

7. Harmonic data including current and Voltage THD at the different load levels shall be included with the test report.

1.4 SPECIFICATION COMPLIANCE REVIEW

- A. Mark up a complete copy of the specification section for the product to indicate a) acknowledgement of the specification requirement (Comply), or b) acknowledgement that the particular specification requirement does not apply to this specific project (Not Applicable) or, c) acknowledgement that the specification requirement cannot be made or that a variance is being submitted for review to the Architect/Engineer/Owner (Does Not Comply, Explanation:) Do not submit an outline form of compliance, submit a complete copy with the product data.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Store and protect products
- B. Store in a warm, dry location with uniform temperature. Cover ventilation openings to keep out dust, water and other foreign material.
- C. Handle transformers using lifting eyes and/or brackets provided for that purpose. Protect against unfavorable external environment such as rain and snow, during handling.

1.6 WARRANTY

- A. Transformer shall carry a 25-year pro-rated warranty, which shall be standard for the product line.

1.7 INTERNATIONAL STANDARDS ORGANIZATION REGISTRATION OF MANUFACTURING PLANT

- A. Registration to current ISO standard is required.
- B. Independent annual audits are conducted.
- C. Product shall be manufactured in registered facility
- D. ISO 9001:2000 Registered – Quality Management System
- E. ISO 14001:2004 Registered – Environmental Management System
 1. Transformer manufacturing can produce significant emissions of volatile compounds and significant other waste. To minimize environmental impact, the transformer must be the product of a manufacturing process that has been independently audited to comply with the ISO 14001:2004 Environmental Management System Standard, where strict quality control of raw material sourcing and construction techniques maximize product efficiency and minimize emissions and waste byproducts.
 2. ISO 14001:2004 ensures that a facility has had an independent environmental impact assessment of raw material sourcing and all manufacturing processes, and has implemented an independent annually audited program that minimizes environmental impact during manufacturing process and includes a strictly monitored continuous improvement program.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS/PRODUCT

- A. Powersmiths E-Saver OPAL
- B. Power Quality International (Z3 e-Rated)
- C. Mirus - ULLTRA

2.2 TRANSFORMER SPECIFICATION

- A. Minimum UL Listed and Labeled K-Rating: K7
- B. Copper-wound, 3-phase, common core, ventilated, dry-type, isolation transformer built to NEMA ST20 and relevant NEMA, UL and IEEE standards; 200% rated neutral; 60Hz rated; Transformers 750 kVA and less, 600 volt primary and less, shall be UL Listed and bear the label. All terminals, including those for changing taps, must be readily accessible by removing a front cover plate. Windings shall be continuous with terminations brazed or welded. 10kV BIL.
- C. Insulation System:
 - 1. Shall be NOMEX-based with an Epoxy Co-polymer impregnate for lowest environmental impact, long term reliability and long life expectancy
 - a. Class: 220 degrees C
 - b. Impregnate Properties for low emissions during manufacturing, highest reliability and life expectancy
 - c. Epoxy co-polymer
 - d. VOC: less than 1.65 lbs./gal (low emissions during manufacturing)
 - e. Water absorption (24hrs @25C): less than 0.05% (superior insulation, longer life)
 - f. Chemical Resistance: Must have documented excellent performance rating by supplier
 - g. Dielectric Strength: minimum of 3200 volts/mil dry (for superior stress, overvoltage tolerance)
 - h. Dissipation Factor: max. 0.02 @25C to reduce aging of insulation, extending useful life
- D. Operating Temperature Rise: Maximum 115 degree C in a 40 degree C maximum ambient
- E. Noise levels:
 - 1. 3dB Below NEMA ST-20
 - 2. Production Test every unit. Data to be available upon request.
- F. Exceed minimum efficiency requirements of US Department of Energy, 10 CFR Part 431, April 18, 2013, Energy Conservation Program: Energy Conservation Standards for Distribution Transformers: Final Rule which takes effect January 1, 2016, and comply with the table of maximum no Load Losses, efficiency requirements at 1/6 load, efficiency at 35% load per 10 CFR Part 431, and efficiency at 25% load under the transformer specified K-rating load profile.

G. Maximum losses and minimum efficiency under linear load conditions per Table 1.

| Table 1 | | | | | | | | | | | | | |
|--|---------------|--------------|---------------|--------------|---------------|--------------|---------------|--------------|---------------|--------------|---------------|--------------|---------------|
| Max and Min Values for Losses and Efficiency for "High Efficiency" Transformers Under K1 Linear and Specified K-Rating Nonlinear Loading | | | | | | | | | | | | | |
| kVA Rating | No Load | 16.5% Load | | | | 25% Load | | | | 35% Load | | | |
| | | K1 Linear | | Nonlinear | | Linear | | Nonlinear | | K1 Linear | | Nonlinear | |
| | Max Loss (kW) | Min Eff. (%) | Max Loss (kW) |
| 15 | 0.054 | 0.066 | 97.38 | 0.067 | 97.36 | 0.082 | 97.86 | 0.085 | 97.78 | 0.109 | 97.97 | 0.117 | 97.82 |
| 30 | 0.091 | 0.112 | 97.79 | 0.113 | 97.77 | 0.138 | 98.19 | 0.144 | 98.12 | 0.183 | 98.29 | 0.200 | 98.13 |
| 45 | 0.124 | 0.152 | 98.00 | 0.154 | 97.97 | 0.187 | 98.36 | 0.197 | 98.28 | 0.248 | 98.45 | 0.276 | 98.28 |
| 75 | 0.181 | 0.221 | 98.24 | 0.225 | 98.22 | 0.273 | 98.56 | 0.288 | 98.49 | 0.362 | 98.64 | 0.404 | 98.48 |
| 112.5 | 0.245 | 0.300 | 98.41 | 0.305 | 98.38 | 0.370 | 98.70 | 0.393 | 98.62 | 0.490 | 98.77 | 0.555 | 98.61 |
| 150 | 0.303 | 0.370 | 98.53 | 0.377 | 98.50 | 0.457 | 98.80 | 0.486 | 98.72 | 0.605 | 98.86 | 0.688 | 98.71 |
| 225 | 0.410 | 0.501 | 98.67 | 0.510 | 98.64 | 0.619 | 98.91 | 0.659 | 98.84 | 0.820 | 98.97 | 0.937 | 98.82 |
| 300 | 0.509 | 0.622 | 98.76 | 0.636 | 98.73 | 0.769 | 98.99 | 0.829 | 98.91 | 1.018 | 99.04 | 1.194 | 98.88 |
| 500 | 0.741 | 0.906 | 98.91 | 0.928 | 98.89 | 1.119 | 99.11 | 1.213 | 99.04 | 1.482 | 99.16 | 1.754 | 99.01 |

H. Voltage Taps: For transformers 30kVA-300kVA, provide two 2-1/2% full capacity taps above and below nominal primary voltage. For transformers 15kVA and smaller as well as 500kVA and larger provide one 5% full capacity tap above and below nominal primary voltage.

I. Impedance: Between 3.0% and 6.0% unless otherwise noted.

J. Enclosure type: Ventilated NEMA 2; NEMA 3RX aluminum or stainless steel when located outdoors, or as indicated otherwise

K. Finish Color: Provide light gray ANSI-61 paint finish for transformers located outdoors. Provide manufacturer's standard paint finish color indoors.

L. Transformer Options:

1. Electrostatic Shield: Each winding is independently single shielded with a full-width copper electrostatic shield

M. Closed delta 120/240-Volt secondary, 3-phase, 4-wire with center tap neutral winding transformers:

1. KVA rating indicated shall be for balanced 3-phase loading. Center tap winding shall allow for a maximum nominal 70-percent of three-phase kVA rating for unbalanced single phase neutral connected 120/240-Volt loads. The center tap winding shall be individually rated or constructed at twice the capacity of each of

the other delta connected windings. (Example: a 225kVA rated center tap transformer would consist of two 75-kVA windings and one 150-kVA center tap winding).

PART 3 – EXECUTION

3.1 INSTALLATION

- A. General: Install transformers where shown, in accordance with the manufacturer's written instructions and industry practices to ensure that the transformers meet the specifications. Comply with requirements of NEMA and NEC standards, and applicable portions of NECA Standard of Installation, for installation of transformers. Transformers shall be floor mounted. Ceiling mounted transformers are not acceptable.
- B. Dry-Type Transformer Mounting: Indoor, floor mount transformer on properly sized Amber/Booth Type RVD rubber-in-shear vibration isolators. Transformer enclosures shall make no contact with wall surfaces.
- C. Conduit directly connected to transformer enclosures shall be flexible liquid tight conduit extending for a minimum of 18-inches and a maximum of 24 inches from transformer enclosure as measured along the conduit centerline. Include a ground wire, size in accordance with NEC, internal in each length of flexible conduit.
- D. Grounding: Ground and bond transformers as a separately derived system unless noted otherwise, refer to NEC 250. Installation of bonding strap or bonding conductor between ground and neutral bus shall be witnessed by the Engineer prior to applying power and terminating secondary conductors.
- E. Check for damage and loose connections.
- F. Set the transformer plumb and level.
- G. Provide Seismic restraints where required.
- H. Coordinate all work in this Section with that in other sections.
- I. Verify all dimensions in the field.
- J. Adjust transformer secondary voltages to provide the required voltage at the loads.

3.2 TESTING

- A. Insulation Tests: Before energizing, check transformer windings for continuity.
- B. Winding Current: During initial no-load energizing, check current in each primary winding.
- C. Tap Settings: Measure and record load current and voltage of transformers while loaded to verify proper transformer tap settings.
- D. Submittals: Furnish instruments and personnel required for tests. Submit four copies of certified test results to Engineer for review. Reports include transformer tested, date and time of tests, relative humidity, temperature, and weather conditions.

- E. Performance Validation: To ensure that the products shipped to the job site meet this specification, provide on-site revenue class accurate efficiency and harmonic measurements of transformers once installed and operating at customer's site. Data shall be collected from primary and secondary sides of the transformer simultaneously on a synchronized cycle by cycle basis. The use of two discrete meters that are not synchronized is not acceptable. Sampling shall be of 10% of transformers on the project once installed and operating, as selected by customer. Submit a detailed report to the project engineer.
- F. Identify non-compliant products to the engineer and replace at no cost to the Owner.
- G. Notification: Notify Engineer in writing of any deviation from manufacturer's pre-shipment test data.

END OF SECTION

SECTION 26 19 13 - COMBINATION MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Motor controller work as required, scheduled and specified.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Schneider Electric - Square D
- B. ABB-General Electric Co.
- C. Siemens
- D. Eaton

2.2 MOTOR CONTROLLERS

- A. General: Combination motor controllers shall consist of an integrally mounted, thermal magnetic or magnetic only circuit breaker disconnect or fused disconnect switch as specified in Section 26 24 25. Magnetic, full voltage non-reversing (FVNR) or two speed controller as required, in a heavy duty type, dead front enclosure, surface-mounted; size and number of poles as required. Controllers shall be constructed and tested in accordance with NEMA Standards. Refer to Division 23 for Variable Frequency Inverter furnished by Division 23, installed by Division 26. Minimum controller size shall be NEMA Size 1.
- B. Contacts: Magnetic controller contacts shall be silver alloy, and not require any filing, dressing, or cleaning for the life of the controller.
- C. Operating Coils: Operating coils shall be 120V, pressure molded and designed so that accidental exposure to excessive voltage up to 480V will not damage the coil. Design controller so that when a coil fails due to over voltage, the controller shall open, and not freeze in the closed position.
- D. Overload Relays: Controllers shall have manual-reset, trip-free, solid state, overload relays in each phase conductor. Three phase FVNR controllers shall have three overload relays. Single-phase FVNR controllers shall have an overload relay in each ungrounded conductor. Two speed, full-voltage magnetic controllers shall have overload relays for all six ungrounded conductors. Overload relays shall not be field-convertible from manual to automatic reset. Provide reset button located in front cover to reset all overload relays.
- E. LED Pilot Lights: Provide 30.5mm run and stop pilot lights for all motor controllers. Furnish additional pilot lights for motor controllers as shown. Provide FAST and SLOW pilot lights for two-speed controllers. Pilot lights shall be mounted in the controller enclosure cover. Pilot lights shall be operated from an interlock on the motor controllers, and not be wired across the operating coil.
 - Green - Stop
 - Red - Run
 - Yellow - Slow
 - Blue - Fast

- F. Controls: Controllers shall have 30.5mm HAND-OFF-AUTOMATIC switches. Provide for FAST-SLOW, REMOTE-LOCAL speed selection from HVAC control system for two-speed controllers. Two-speed controllers shall have deceleration relays between fast and slow speeds. Coordinate motor controller controls with the requirements of Division 23. Motor controller controls shall be mounted in the controller enclosure cover. Control switches shall be un-keyed rotary switches.
- G. Control Power: A single phase control power transformer shall be included with each controller for 120V control power. The primary shall be connected to the line side of the motor controller through two fuses; the secondary shall have one leg fused and one leg grounded. Arrange transformer terminals so that wiring to terminals is not located above the transformer.
- H. Auxiliary Contacts: Each controller shall have two normally open and two normally closed nonconvertible auxiliary contact in addition to the number of contacts required for the holding interlock and control wiring. One or more additional auxiliary contacts can be field installed without removing existing wiring, or removing the controller from its enclosure.
- I. Phase Failure Monitors: Provide a 3-phase failure monitor for each motor controller. Monitor on any or all phases, for phase reversal from A-B-C sequence, under/over voltage, and phase failure. Provide adjustable relay for trip range. Provide automatic reset upon restoration of power to all phases. Where solid state overload relays provide this specified requirement, separate phase failure relays may be omitted.
- J. Unit Wiring: Unit shall be completely pre-wired to terminals to eliminate any interior field wiring except for: connection of power supply conductors to switch line side terminals; motor leads to the controller load side terminals; and control conductors to holding coil terminals.
- K. Enclosure:
 - 1. Motor Controllers installed in indoor locations shall be NEMA 1 heavy duty enclosures unless shown otherwise.
 - 2. Motor Controllers installed at kitchen and food preparation locations, hose down areas, cooling towers, exterior locations, and in other corrosive areas shall be NEMA 4X, Type 316 stainless steel.
- L. Minimum interrupting rating shall be 35KAIC.

2.3 MANUAL MOTOR CONTROLLERS

- A. General: Manual motor controllers shall consist of an integral controller and overload protection in a common enclosure, surface mounted. Size and number of poles shall be as shown and required with pilot light.
- B. Manual Motor Controller: Manual motor controller with overload protection, 1 HP maximum, 115 or 230V.
- C. Enclosures:
 - 1. Manual motor controllers installed in indoor locations shall be NEMA 1 heavy duty enclosures unless shown otherwise.
 - 2. Manual motor controllers installed at kitchen and food preparation locations, hose down areas, cooling towers, exterior locations, and in other corrosive areas shall be NEMA 4X, Type 316 stainless steel.
- D. Disconnect Switch: For self-protected motors where one pole toggle motor control switch is allowed, the switch shall be horsepower rated and as specified for toggle switches in Section

26 27 73.

PART 3 - EXECUTION

3.1 INSTALLATION OF MOTOR CONTROLLERS

- A. General: Install combination motor controllers where required or indicated and in accordance with the manufacturer's written instructions, requirements of the NEC and NECA Standard of Installation, and industry practices. Do not install motor controllers above ceilings. Do not install motor controllers on roofs.
- B. Overloads: Install overload relays with manual reset in each phase of motor controller. Overload adjustable settings shall be based on actual motor nameplate full load amps. Field verify nameplate full load amps and adjust all relay settings accordingly.
 - 1. Set overcurrent at motor service factor x motor nameplate FLA
 - 2. Set high voltage trip to 8.3 percent above nominal voltage
 - 3. Set undercurrent trip to four automatic restarts
 - 4. Set all other trips to zero auto restarts
 - 5. Phase Failure Relay: Adjust phase failure relay to 10 percent over voltage and 10 percent under voltage.
- C. Coordination: Motor controllers shall be provided to coordinate with motors furnished by Division 23. Motor controller controls shall be provided to coordinate with controls specified in Division 23.
- D. Supports: Provide individual and combination motor controllers with galvanized angle or other suitable supports if mounting on wall or other rigid surface is impractical. Controllers shall not be supported by conduit alone. Where motor controllers are mounted on equipment served, the switch shall not inhibit removal of any service panels or interfere with any required access areas. Manual motor controllers shall be installed plumb and aligned in the plane of the wall where they are installed.
- E. Identify each motor controller as specified in Section 26 05 00.
- F. Where motor controllers are indicated to be installed as part of a Motor Control Center, refer to the Motor Control Center specification.

3.2 TESTING

- A. Provide the field services of the manufacturer to provide initial programming of all variable functions, start-up and commissioning of each motor controller.
- B. Pre-Energization Check: Check motor controllers for continuous circuits and short circuits.
- C. Post Hook-Up Test: After wire and cable hook-ups, energize motor controller to show it functions as specified.
- D. Provide thermal infrared scan of the combination motor controllers rated 200 Amps or larger under full load prior to testing / maintenance and modifications and of the modified and new switchboard sections after construction as directed and witnessed by Owner. Make corrections as needed as soon as possible as directed by the Owner. Repeat the scan at the 11-month prior to closeout, and make corrections prior to closeout. Provide digital video documentation with test results for comparison between prior condition and post construction modifications and future tests.

END OF SECTION

**SECTION 26 24 14 - TESTING, MAINTENANCE, AND MODIFICATIONS TO
EXISTING SWITCHBOARDS AND FEEDER DISTRIBUTION PANELBOARDS**

PART 1 -GENERAL

1.1 WORK INCLUDED

- A. Work Included: Switchboard and distribution panel work to existing switchboards or distribution panelboards 800 Amps or more and 600 volts or less as shown, scheduled, indicated, and specified.
- B. Types: Work for the project includes switchboards and feeder distribution panelboards.

1.2 QUALITY ASSURANCE

- A. Original Equipment Manufacturer's (OEM's) Installation and Maintenance Instructions. Coordinate with the OEM's field service representative for specific recommendations for the equipment involved prior to evaluation, testing, and maintenance procedures.
- B. NEMA Compliance: Comply with National Electrical Manufacturers Association (NEMA) Standard PB1 "Panelboards", and Standard PB2, "Dead-Front Distribution Switchboards."
- C. Testing shall be performed by the OEM an InterNational Electrical Testing Association (NETA) National Accredited Company (NAC) and by NETA Certified Technicians with the appropriate NETA level of certification for the testing required.

1.3 SUBMITTALS

- A. Indicate Original Manufacturer's Installation and Maintenance Instructions for testing, exercising, cleaning, and lubrication where available.
- B. Include electrical characteristics including voltage, frame size and trip ratings, withstand ratings, and time current curves of all equipment and components.
- C. Original Manufacturer's Inspection Report when available.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Replacement parts shall be manufactured by Original Equipment Manufacturer, (OEM) when available. When OEM parts are not available, third party, UL recognized, manufactured parts may be used. Provide written confirmation on Manufacturer's letterhead indicating OEM parts are not available.

2.2 MATERIALS AND COMPONENTS

- A. Except as otherwise indicated, provide manufacturer's standard materials and components as indicated by published product information, designed, and constructed as recommended, and as required for a complete installation.

2.3 NEW OVERCURRENT DEVICES AND/OR NEW ACCESSORIES

- A. New Indicating Instruments where indicated: Switchboard instrumentation shall be digital display, panel mounted, rated for 120V, 60 hertz. The display unit shall be UL listed in accordance with UL 508. The electronic metering device shall have the following features:
1. Voltmeter, phase to phase and phase to ground or neutral.
 2. Current, per phase RMS and 3 phase coverage.
 3. Demand current per phase.
 4. Power factor per phase and 3 phase average.
 5. Real power, 3 phase total.
 6. Reactive power, 3 phase total.
 7. Apparent power, 3 phase total.
 8. Frequency.
 9. Average demand real power.
 10. Adjustable demand interval (5 to 60 minutes).
 11. Nonvolatile memory.
 12. Password protected set-up and reset.
 13. 3 current transformers with primary to match bus size and 5 ampere secondary with metering class accuracy.
 14. Full scale readouts with the following accuracy:
 - a. Current and voltage measurement +/-0.1%
 - b. Power and energy +/-0.2%
 - c. Frequency +/-0.5%
 - d. Power Factor +/-1.0%
 - e. Data update time 0.5 seconds(4 wire)
 15. Metering Output.
 - a. Pulse output based on kWh, kvarh, or kVAh.
 - b. Analog output 4-20mA based on kWh, kvarh, or kVAh.
 16. Monitoring:
 - a. Harmonic analysis through 63rd with THD and TIF.
 - b. Event recorder.
 - c. Waveform capture.
 - d. Data logger.
 - e. Triggered trace memory.
 17. Communication:
 - a. Front port and dual rear mounted RS485 ports.
 - b. BACnet protocol (coordinate with BMCS contractor).
 - c. Mini RTU: digital 4 in/4 out.
 - d. Analog 1 in/4 out.
 - e. Local/remote display of all values.
 18. Software:
 - a. Windows based software shall be provided to enable setpoint programming.
- B. New Feeder and Branch Protective Devices greater than 1,200 Amps shall be individually mounted:
1. Molded case circuit breakers:
 - a. Adjustable: current, I²t settings, ground fault (where required), instantaneous trip, and short time trip. Solid state trip true RMS sensing, without fusible elements; 100-percent continuous current rating.
 - b. Energy Reducing Maintenance System switch with local status indicator (ERMS).
 - c. Shunt trip capability and wiring to terminal block for remote shunt trip switch wiring termination weather remote trip device is indicated or not.
 2. Fusible switches:

- a. Each switch shall have an individual door over the front, equipped with a voidable interlock that prevents the door from being opened when the switch is in the ON position unless the interlock is purposely defeated by activation of the voiding mechanism. All switches shall have externally operated handles.
 - b. Fused switches 600 Amps and below, equipped for class J fuses.
 - c. Fused switches 601 Amps and above shall be equipped with Class R or L rejection type fuse holders. Class RK1 or L of ampere rating and type as indicated on the plans suitable for application of the system.
 - d. When required by the latest edition of the NEC or the AHJ, 1,200 Amp switches regardless of fuse size installed shall have Energy Reducing Maintenance System switch with local status indicator (ERMS).
- C. Feeder and Branch Protective Devices 1,200 Amps and below shall be group mounted:
1. Molded case circuit breakers:
 - a. Greater than 250 Amp: Solid state true RMS sensing with adjustable: current, I²t settings, ground fault (where required), instantaneous trip, and short time trip; 80-percent continuous current rating.
 - b. 250 Amp and smaller: Solid state true RMS sensing with fixed current setting by rating plug or dial. Breaker shall have adjustable instantaneous trip function with short time tracking.
 - c. 1,200 Amp frame circuit breakers regardless of trip shall have Energy Reducing Maintenance System switch with local status indicator (ERMS).
 2. Fusible switches:
 - a. Quick-make, quick-break units utilizing the double-break principle of circuit interrupting to minimize arcing and pitting and shall conform to the ratings shown.
 - b. Individual door over the front, equipped with a voidable interlock that prevents the door from being opened when the switch is in the ON position unless the interlock is purposely defeated by activation of the voiding mechanism. All switches shall have externally operated handles.
 - c. 600 Amps and below equipped for Class J fuses.
 - d. 601 Amps and above shall be equipped for Class R or L rejection type fuse holders.
 - e. When required by the latest edition of the NEC or the AHJ, 1,200 Amp fused switches regardless of fuse size installed shall have Energy Reducing Maintenance System switch with local status indicator (ERMS).

PART 3 – EXECUTION

- 3.1 INSTALLATION, MAINTENANCE, AND MODIFICATION OF SWITCHBOARDS AND FEEDER DISTRIBUTION PANELBOARDS
- A. Comply with the requirements of NEMA, NEC, and NECA Standards for installation, for installation of switchboards and panelboards. Comply with Original Manufacturer's Operation and Maintenance Instructions for testing and periodic maintenance.
 - B. Torque all existing and new bus connections and tighten mechanical fasteners to manufacturer's specifications.
 - C. Install fuses, of ratings shown, in each new or modified fused switch.

TESTING, MAINTENANCE, AND MODIFICATIONS TO
EXISTING SWITCHBOARDS AND FEEDER DISTRIBUTION PANELBOARDS

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- D. Adjustment: Adjust operating mechanisms for free mechanical movement. Adjust circuit breaker time characteristic curves as directed by the OEM for coordination with downstream overcurrent devices.
- E. Existing Indicating Instruments: Test and calibrate to original manufacturer's specifications. Replace batteries in existing digital instruments where batteries are required. Replace defective indicating instruments with new digital instruments. Provide new digital indicating instruments where indicated on the drawings.
- F. Cleaning: Vacuum the interior of the existing enclosures of all dust and foreign matter. Clean all existing switch contacts according to manufacturer's instructions.
- G. Lubrication: Lubricate all existing exposed switch contacts, pivot points and bearings according to manufacturer's instructions.
- H. Remove any existing circuit breakers or fusible switches that are not functional or not suitable to be reused as "spares".
- I. Provide filler plates where required.
- J. Existing enclosures which indicate rust or corrosion shall be repainted; paint indoor non-stainless steel enclosures with ALKYD enamel coat, and outdoor non-stainless steel enclosures with epoxy enamel coat to match existing color. Do not paint over labels or listings.
- K. Mimic bus: Update the existing mimic bus or provide new mimic bus to indicate busing, connections, and devices in single line form on the fronts of switchboards. Use red colored plastic strips or match exiting material and color format, fastened flat against the panel face with screws.

3.2 TESTING

- A. Provide the services of a NETA NAC or Original Manufacturer's Field Services personnel for initial testing at no additional cost to the Owner. The NETA NAC or Original Manufacturer's Field Services personnel shall provide at minimum, a visual inspection of the existing switchboards or panelboard and shall provide a written report with recommendations regarding the existing condition and recommendations to further testing, maintenance, and in regard to the specified modifications of the existing switchboard or panelboard. The report shall include any deficiencies of the existing switchboard in relation to each component's intended function. In addition, provide deficiencies of the existing switchboard or panelboard with regard to the current National Electrical Code. Provide the written report to the Architect within 14 days of notice to proceed and prior to any demolition or construction. All other testing, maintenance, and modifications shall be provided by the Contractor as specified at no additional cost to the Owner.
- B. Pre-Energization Checks: Before energizing, check for continuous of circuits and for short circuits. Test existing Bolted Pressure Switches according to Original Manufacture's Instructions.
- C. Insulation Resistance Test: Each bus shall be insulation resistance tested after installation and modification is complete except for line and load side connections. Tests shall be made using Biddle Megger or equivalent test instrument at a voltage of not less than 1000 vDC. Resistance shall be measured from phase-to-phase and from phase-to-

ground. Minimum acceptable value for insulation resistance is 2 megohms.

- D. Ground Fault Protection System Test: After completion of construction and before final acceptance testing, the ground fault protection system shall be field-tested and reset to the manufacturer's recommended settings for both current and time by a representative of the manufacturer's engineering service department. After the test, set ground fault to 1,200 Amps or 50-percent of the circuit breaker or fused switch frame size, whichever is lowest.
- E. All circuit breakers with adjustable trip settings shall fully tested to verify all fixed and adjustable overcurrent and ground fault trip settings are set to the proper setting and function within manufacture's recommended tolerances.
- F. Provide thermal infrared scan of the under full load prior to testing/maintenance and modifications and of the modified or new equipment sections after construction as directed and witnessed by Owner. Make corrections as needed as soon as possible as directed by the Owner. Repeat the scan at the 11-month prior to close out and make corrections prior to close-out. Provide digital video documentation with test results for comparison between prior condition and post construction modifications and future tests.
- G. Submittals: Furnish instruments and certified personnel required for tests. Submit 4 copies of certified test results to the Architect for review. Test reports shall include project location, testing contractor and testing technician's contact information, equipment tested, date and time of test, relative humidity, temperature, and weather conditions.

END OF SECTION

SECTION 26 24 16 - PANELBOARDS AND ENCLOSURES

PART 1 – GENERAL

1.1 WORK INCLUDED

- A. Panelboards and enclosures, including cabinet, as shown, scheduled, indicated, and specified.

1.2 QUALITY ASSURANCE

- A. UL Standards: Panelboards and enclosures shall confirm to all applicable UL standards and shall be UL labeled.

1.3 SUBMITTALS

- A. Indicate:
 1. Detailed dimensions.
 2. Enclosure material, finish, and NEMA classification type.
 3. Location of main circuit breaker.
 4. Mounting and trim.
 5. Acceptable incoming conductors' size.
 6. Electrical characteristics including voltage, ampacity, overcurrent device frame size and trip ratings, bus material and rating, withstand ratings, lugs, and time current curves of all overcurrent devices and components.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Schneider Electric - Square D
- B. ABB-General Electric Co.
- C. Siemens

2.2 MATERIALS AND COMPONENTS

- A. General: Panelboards shall be dead-front type equipped with fusible switches or circuit breakers as shown and as required.
- B. The overcurrent protective device short circuit, coordination and arc flash studies performed by the overcurrent protective device manufacturer shall be used by the respective switchgear vendor(s) to select appropriate equipment, switchgear, and overcurrent protective device characteristics such as but not limited to: equipment bracing, AIC rating, circuit breaker frame size and trip settings, and fuse type/class. The appropriate equipment suitable and required by the studies for code compliance shall be included with the submittal data for review and provided at no additional cost to the Owner. The appropriate equipment recommended by the studies for enhanced selective coordination or enhanced arc flash energy reduction beyond code compliance shall be included with the submittal data for review and consideration purposes by the engineer.
- C. Busing Assembly: Panelboard phase, neutral, and equipment ground busing shall be copper. Bus structure and mains shall have ratings as shown and scheduled. Furnish a bare uninsulated ground bus inside each panelboard enclosure. Two section

panelboards shall be connected with copper cable, with an ampacity conforming to the upstream overcurrent device. Neutral bus termination quantity for branch circuit panelboards shall match or exceed the maximum number of single pole circuit breakers the panelboard will accept.

- D. Main circuit breakers and feeder / branch circuit breakers:
1. Less than 125 Amps: Thermal magnetic with factory fixed trip.
 2. 125-600 Amps: Thermal magnetic with adjustable instantaneous trip of 5X – 10X with short time tracking.
 3. 601 Amps and larger: Solid state true RMS sensing with adjustable: current set by rating plug or adjustable dial, I²t settings, ground fault (where required), instantaneous trip, and short time trip; 80-percent continuous current rating.
 4. Provide permanent lock-off device for all fire alarm system branch circuit breakers, for all smoke control fans and equipment, and where indicated or required for circuit breaker to be used as a remote safety disconnect switch.
 5. General requirements:
 - a. Make prepared space provisions for additional breakers or fused switches so that no additional bus or connectors will be required to add circuit breakers or fused switches in the available device mounting space.
 - b. Two and three pole breakers shall have internal common trips.
 - c. All circuit breakers used as the main or branch mounted back-fed main shall be bolt-on. All circuit breakers used in 600 Amp and smaller panelboards shall be bolt-on breakers. Circuit breakers for distribution panelboards rated 601 amps and larger shall have plug-on or bolt-on circuit breakers.
 - d. Branch circuit panelboard shall have interrupting capacity as shown or as required, but in no case less 10k AIC for 120/208/240-Volt systems, and 18k AIC for 277/480-Volt systems.
 - e. 15 and 20 Amp circuit breakers for lighting circuits shall be UL listed switch duty (SWD).
 - f. Personnel ground fault interrupter (GFI) circuit breakers, where shown, shall be maximum 5 mA ground fault trip and shall include a TEST button.
 - g. Equipment ground fault interrupter (EGFI/EGPD) circuit breakers, where shown or required shall be 30mA ground fault trip and shall include TEST button.
 - h. Circuit breakers with 1,200 Amp and larger frame shall have Energy Reducing Maintenance Switching with local status indicator (ERMS).
- E. Fusible Switches for distribution panelboards: Fusible switches shall be quick-make, quick-break type. Each switch shall be enclosed in a separate steel enclosure. The enclosure shall employ a hinged cover for access to the fuses. Interlock cover with the operating handle to prevent opening the cover when the switch is in the ON position. This interlock shall be constructed so that it can be overridden for testing fuses without interrupting service. The switches shall have padlocking provisions in the OFF position. Switches shall include positive pressure rejection type fuse clips for use with UL Class J fuses and be UL labeled for 200,000 AIC.
- F. Spaces: Where space for future breakers or switches is shown, panelboard enclosure shall include removable blank panels or knockouts to allow installation of future breakers or switches, prepared spaces, and panelboard busing shall be complete, including required connectors.
- G. Integrated Equipment Rating: Do not apply series ratings. Each panelboard, as a

complete unit, shall have a short-circuit rating equal or greater than the available short circuit current. Rating shall have been established by tests on similar panelboards with the circuit breakers or fusible switches installed.

- H. GFCI circuit breakers not available in the required panel AIC rating shall be series rated with the upstream over current protection device to provide the panelboard with required AIC rating. Coordinate series rating requirements with manufacturer. Mark the panel per NEC 110. The marking shall be visible and state the following: "CAUTION-ENGINEERED SERIES COMBINATION SYSTEM RATED XXX AMPERS. IDENTIFIED REPLACEMENT COMPONENTS REQUIRED".
- I. Panelboard Enclosures:
 - 1. Provide sheet steel enclosures, minimum 16-gauge nominal thickness, with multiple knockouts, unless shown otherwise. Provide all NEMA 1 panelboard fronts with spring-loaded door pulls, and flush lock and key, panelboard enclosures keyed alike to match the Owner's standard key system; coordinate with Owner.
 - 2. All NEMA 1 enclosure panelboards shall be hinged "door-in-door" type with interior hinged door with hand operated latch or latches, as required providing access only to circuit breaker or fusible switch operating handles, not to exposed energized parts. Outer hinged door shall be securely mounted to the panelboard box with factory bolts, screws, clips, or other fasteners, requiring a tool for entry. Hand operated latches are not acceptable. Push inner and outer doors shall open left to right. Manufacturer hardware (OEM), screws, and bolts shall be used to secure dead fronts and covers. Do not use third party hardware. Do not use power tools to secure panel hardware. Provide gray powder coat finish over a rust inhibitor.
 - 3. Equip with interior circuit directory frame, card, and clear plastic covering for panelboards.
 - 4. Panelboards located in kitchen preparation or natatorium areas shall have Type 316 stainless steel front, door, and trim with a NEMA 1 rating for the entire enclosure.
 - 5. Panelboards at exterior locations shall be NEMA 4X Type 316 stainless steel.
 - 6. Panelboards at hose down areas, cooling towers, in greenhouses, and other corrosive locations shall be NEMA 4X 316 stainless steel.
 - 7. Enclosure shall be for recessed or surface mounting as shown or as required.
 - 8. Enclosures shall be fabricated by the same manufacturer as panelboards to be enclosed. Multi-section panelboards shall have same physical dimensions.

PART 3 – EXECUTION

3.1 INSTALLATION OF PANELBOARDS AND ENCLOSURES

- A. General: Install panelboards and enclosures, as shown, including electrical connections, in accordance with the manufacturer's written instructions, the requirements of NEC, NECA Standard of Installation, and industry practices. Circuit breakers shall be factory installed except for required field modifications due to actual site conditions.
- B. Coordination: Coordinate installation of panelboards and enclosures with conductor and raceways installation work.
- C. Anchoring: Anchor enclosures to walls and structural surfaces ensuring that they are permanently and mechanically secured.

- D. Directory Card: Provide a typed circuit directory card(s) upon completion of work. Directory card shall be of super heavy-weight index card stock, 110 lb, white. Directory shall include type of load (i.e.: receptacles, lighting, exhaust fan, etc.) and location (i.e.: Room 102, Office, etc.) Room number shall be identified as the actual graphics room number assigned to the space and not the room number identified on the Plans. Circuits with shunt trip shall be identified with the control circuit operating the shunt trip (i.e.: Kitchen Hood No. 2). Shunt trip breakers with common trip circuit shall be grouped in the panelboard (i.e.: circuits 1, 3, 5 and 7).
- E. Fuses: Install fuses, of the ratings and class shown.
- F. Circuit Arrangement: Branch circuits shall be arranged to provide the best possible phase balance, unless shown otherwise.
- G. Panelboards not intended to be used as service entrance (SE) rated or for establishing a separately derived neutral system shall have the factory installed neutral to ground bonding screws and straps removed and disposed of.
- H. Recessed or flush mounted panelboards: Terminate spare conduits in junction box 18-inches above accessible ceiling close to panelboard location. Label junction box cover as "not used" and include panel identification.
 - 1. Provide (3) 1-inch and (3) ¾-inch spare conduits above accessible ceiling to j-box from each panelboard section.
 - 2. Where recessed panelboard is located above another building floor, also provide (3) 1-inch and (3) ¾-inch conduits to j-box in ceiling space on floor below.
- I. Conductors shall be bent neatly opposite the fuse switch or circuit breaker to which they are to be attached. Vertically installed conductors shall be neatly tie-wrapped. Conductors shall be connected in a neat and professional manner. Conductors brought in from the top or bottom of the cabinet shall be bent neatly opposite the fuse or circuit breaker to which they are to be attached. Each conductor shall be run along the full height of the panel and returned to the circuit breaker or fuse location to allow relocation of the conductor to any position along the bus. Panelboard shall be cleaned of all construction debris prior to substantial completion review. Neutral and grounding conductors shall be installed similar to the phase conductors.
- J. Circuit breakers and conductors installed for SPD devices shall be located on the same side as the SPD to allow the shortest and straightest run of conductors in respect to the location of the SPD device. Route all conductors to the SPD device with straight as possible run, using longest sweep bends and the shortest conductor length possible. Twist all SPD conductors and secure with tie straps wherever possible.
- K. Install copper ground bus for copper ground conductors. Ground conductors size #1 and larger are to be landed to panelboard enclosure with mechanical lugs and not to ground bus.
- L. Install panels so that breaker number 1 is the top left breaker.
- M. In panels that contain multi-layered neutral bus, install neutrals beginning with the back neutral bus row and work forward. Do not make up neutrals on front neutral bus row unless all other rows are full.
- N. Label breaker mounting space with stick-on number labels.
- O. Mount the fully aligned panelboard such that the maximum height of the top circuit

breaker above the finished floor shall not exceed 78-inches. Mount panelboards as high as practical and such that the bottom of the cabinets will not be less than 6 inches above the finished floor.

3.2 TESTING

- A. Before energizing, energization, check for continuity of circuits and short circuits.
- B. Provide thermal infrared scan of panelboards under full load as directed and witnessed by Owner. Correct any deficiencies causing abnormal heating and repeat the scan. Provide digital video documentation with deficiencies corrected for comparison to future test. Make corrections as needed as soon as possible as directed by the Owner. Repeat the scan at the 11-month prior to closeout and make corrections prior to close-out.

END OF SECTION

SECTION 26 24 25 - ENCLOSED SWITCHES

PART 1 – GENERAL

1.1 WORK INCLUDED

- A. Safety and disconnect switch work where required, scheduled, indicated, specified, and required. For switches indicated or rated above 1,200 Amps, provide switchboard construction as specified for switchboards.
- B. UL Approved: Safety and disconnect switches shall have UL approval and the UL label.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Schneider Electric - Square D
- B. ABB-General Electric Co.
- C. Siemens

2.2 ENCLOSED SWITCHES

- A. General: Provide heavy duty type, dead-front, sheet steel enclosed, surface-mounted safety switches of the type and size indicated. Safety switches shall be rated for the voltage of the circuit where they are installed. Safety switches used as motor disconnects shall be rated for the motor horsepower served.
- B. The overcurrent protective device short circuit, coordination and arch flash studies performed by the overcurrent protective device manufacturer shall be used by the respective switchgear vendor(s) to select appropriate equipment, switchgear, and overcurrent protective device characteristics such as but not limited to: equipment bracing, AIC rating, circuit breaker frame size and trip settings, and fuse type/class. The appropriate equipment suitable and required by the studies for code compliance shall be included with the submittal data for review and provided at no additional cost to the Owner. The appropriate equipment recommended by the studies for enhanced selective coordination or enhanced arc flash energy reduction beyond code compliance shall be included with the submittal data for review and consideration purposes by the engineer.
- C. Switch Mechanism:
 - 1. Safety switches shall be quick-make, quick-break type with permanently attached arc suppressor. Constructed so that switch blades are visible in the OFF position with the door open. The operating handle shall be an integral part of the box, not the cover. Switch shall have provision to padlock in the OFF position. Safety switches shall have a cover interlock to prevent unauthorized opening of the switch door when the switch mechanism is in the ON position, or closing of the switch mechanism when the switch door is open.
 - 2. Cover interlock shall have an override mechanism to permit switch inspection by authorized personnel. Current-carrying parts shall be constructed of high conductivity copper with silver-plated switch contacts. Lugs shall be suitable for copper conductors and front removable.
- D. Neutral: Provide safety switches with number of switched poles indicated. Where a

neutral is present in the circuit, provide a solid neutral with the safety switch. Where a ground conductor is present in the circuit, provide a separate solid ground with the safety switch.

- E. Auxiliary Contacts: Disconnect switches related to all smoke control fans shall have auxiliary contacts for fire alarm system monitoring of the position of the disconnect switch.

2.3 ENCLOSED SWITCHES WITH OVERCURRENT AND/OR GROUND FAULT PROTECTION

- A. Overcurrent protective devices 1,200 Amps and below:
 - 1. Where switch is intended as a building service disconnect provide solid neutral and ground bus and service entrance SE rating.
 - 2. Molded case circuit breakers:
 - a. Greater than 800 Amp: Solid state true RMS sensing with adjustable: current, I²t settings, ground fault (where required), instantaneous trip, and short time trip; 80-percent continuous current rating.
 - b. 800 Amp and smaller: Solid state true RMS sensing with fixed current setting by rating plug or dial. Breaker shall have adjustable instantaneous trip function with short time tracking.
 - c. 1,200 Amp and larger frame circuit breakers regardless of trip shall have Energy Reducing Maintenance System switch with local status indicator (ERMS).
 - 3. Fusible switches:
 - a. Quick-make, quick-break units utilizing the double-break principle of circuit interrupting to minimize arcing and pitting and shall conform to the ratings shown.
 - b. Individual door over the front, equipped with a voidable interlock that prevents the door from being opened when the switch is in the ON position unless the interlock is purposely defeated by activation of the voiding mechanism. All switches shall have externally operated handles.
 - c. 600 Amps and below equipped for Class J fuses.
 - d. 601 Amps and above shall be equipped for Class R or L fuses.
 - e. When required by the latest edition of the NEC or the AHJ, 1,200 Amp fused switches regardless of fuse size installed shall have Energy Reducing Maintenance System switch with local status indicator (ERMS).
- B. Ground Fault Interrupter (GFI) protection: Where shown or required, ground fault protection shall be achieved with adjustable pickup for ground fault currents, field-adjustable from 200 amperes and instantaneous to 60 cycle time delay. The ground fault protection system shall include necessary current sensors, internal wiring, and relays to coordinate opening the monitored faulted circuits.
 - 1. Ground fault protection shall be set at minimum setting for both current and time during construction. The manufacturer shall include in the submittal data the minimum setting of the device and the recommended setting for normal building operation.
 - 2. The ground fault system shall be factory-tested before shipment as specified:
 - a. The manufacturer shall provide a factory ground fault protection system test for circuit testing and verification of tripping characteristics. The manufacturer shall pass predetermined values of current through the sensors and measure the tripping time for each phase and neutral. The measured time-current relationships shall be compared to the trip-characteristic curves. If the ground fault device trips outside the range of

values indicated on the curve, the ground fault device shall be replaced or recalibrated.

- b. Relays, electrically operated switches, shunt-trip switches, circuit breakers, and similar items shall have proper voltages applied to their circuits and satisfactory operation demonstrated.
- c. Upon completion of the factory ground fault protection system test, the current and time on each ground fault device shall be set to minimum values.

2.4 ENCLOSURES

- A. Enclosures in indoor locations shall be NEMA 1 unless shown otherwise.
- B. Enclosures in exterior locations shall be NEMA 4X stainless steel.
- C. Enclosures at kitchen and food preparation locations, exterior kitchen supply and exhaust fans, hose down areas, cooling towers, in greenhouses, and in other corrosive areas shall be NEMA 4X, stainless steel.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. General: Install safety and disconnect switches where required or indicated, in accordance with the manufacturer's written instructions, requirements of the NEC, NECA Standard of Installation, and industry practices. Provide fuse identification label when fused switches are required showing type and size inside door of each switch. Include devices in coordination study to indicate overcurrent devices will selectively coordinate.
- B. Location: Provide safety switches within 50' and in sight of motor served. There shall be minimum code required clearance in front of safety switch and a clear path in which to access the switch. (i.e.: not having to walk and/or stand on obstacles such as drain pans on floor to service).
- C. Supports: Provide all safety and disconnect switches with galvanized angle or other supports where mounting on wall or other rigid surface is impractical. Switches shall not be supported by conduit alone. Where safety and disconnect switches are mounted on equipment served, the switch shall not inhibit removal of service panels or interfere with access areas, not void the warranty of the equipment served. Provide mounting hardware that will allow removal of safety and disconnect switches with common work tools. Do not utilize drive pin anchors through enclosure.
- D. Ground Fault Interrupter (GFI) test and settings: Where adjustable ground fault interrupter settings are provided or required, after completion of construction and before final acceptance testing, the ground fault protection system shall be field-tested and reset to the manufacturer's settings for both current and time by a representative of the manufacturer's engineering service department. After the test, set ground fault to 50-percent of the overcurrent device rating.
- E. Safety and Disconnect Switches: Install disconnect switches for motor-driven equipment, appliances, motors, and motor controllers within sight of the controller position unless indicated otherwise.

- F. Variable Frequency Drive (VFD) Warning Plaque: Provide VFD warning plaque at safety disconnect switches which are located down-stream of VFDs. Secure plaque to disconnect switch or immediately adjacent to disconnect switch with fasteners. Plaque shall be Yellow-White-Yellow 3-layer plastic laminated engraved with: "WARNING" (1/2 Inch Letters). "TURN OFF VFD BEFORE OPENING THIS SWITCH FOR MAINTENANCE." (1/4 inch letters).
- G. Provide disconnect switch for electric duct heaters.
- H. Where disconnect switch is used or indicated as the utility service building disconnect, provide main bonding jumper and neutral to ground bond connected to the building's grounding system. Do not bond neutral to ground when there is a neutral to ground bond upstream from the same derived neutral system serving the disconnect switch.
- I. Disconnect switches related to all smoke control fans shall have auxiliary contacts for fire alarm system monitoring of the position of the disconnect switch, coordinate with Division 28. Coordinate with fire detection and alarm contractor for the fire alarm and detection system to monitor all disconnect switches open/closed position that serve the smoke control system. All fire alarm and control wiring directly related to the monitoring of the supply power disconnect switches and control of the smoke control fans shall be installed in conduit.

3.2 TESTING

- A. General: Before energizing, check for continuity of circuits and short circuits.
- B. Provide thermal infrared scan of the enclosed switches rated 200 Amps or larger under full load prior to testing / maintenance and modifications and of the modified and new switchboard sections after construction as directed and witnessed by Owner. Make corrections as needed as soon as possible as directed by the Owner. Repeat the scan at the 11-month prior to closeout, and make corrections prior to closeout. Provide digital video documentation with test results for comparison between prior condition and post construction modifications and future tests.

END OF SECTION

SECTION 26 24 30 - FUSES

PART 1 – GENERAL

1.1 WORK INCLUDED

- A. Fuse work as shown and scheduled, and as specified.
- B. Types: Fuses required for the project include the following:
 - 1. 250 volt current limiting fuses
 - 2. 600 volt current limiting fuses

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturers: Provide products produced by Bussman or Littlefuse.

2.2 CURRENT LIMITING FUSES - 600 VOLTS AND LESS

- A. General: Provide 200,000 amperes interrupting capacity (AIC) current-limiting fuses of the current ratings shown and voltage rating equal to or greater than the voltage at the point of application.
- B. Types:
 - 1. Fuses in circuits supplying individual motors, groups of motors, or loads including motors, 600 amperes or less, shall be UL Class RK1 or Class J, time delay fuses, Bussman LPS-RK (600V) LPJ-SP (600V), LPN-RK (250V).
 - 2. Fuses in circuits supplying individual motors, groups of motors, or loads including motors, 601 to 4000 amperes, shall be UL Class L time delay fuses, Bussman KRPC "HI-CAP".
 - 3. Fuses in circuits supplying other than motor loads, 600 amperes or less, shall be UL Class RK1, time delay fuses, Bussman LPS-RK (600V), LPN-RK (250V).
 - 4. Fuses supplying surge protection devices (SPD) shall be surge rated for use with SPD devices.

2.3 SPARE FUSES

- A. General: Provide spare fuses in the amount of 10% of each type and size installed, but not less than 3 spares of a specific size and type. Deliver to the Owner at the time of project acceptance. Fuses shall be encased in a labeled steel enclosure with padlock provision, to be wall mounted where directed.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. General: Install fuses in fuse holders immediately before energizing of the circuit where the fuses are installed. Fuses shall not be installed and shipped with equipment.
- B. Labels: Place fuse identification labels, showing fuse size and type installed, inside the cover of each switch.

END OF SECTION

SECTION 26 27 73 - LINE VOLTAGE WIRING DEVICES

PART 1 – GENERAL

1.1 WORK INCLUDED

- A. Provide wiring device work as shown, scheduled, indicated, and specified. Low voltage and/or digital control switches required for lighting controls and lighting control systems shall be as specified and required for the low voltage and / or digital control lighting system. Refer to drawings or other specification sections for low voltage / digital lighting control systems. Cover plates for lighting control systems shall be as specified in this section unless specifically required otherwise by the low voltage / digital control device bulkhead or form factor.

1.2 QUALITY ASSURANCE

- A. UL Label: Wiring devices shall be UL labeled.
- B. NEMA Standard WD1 and WD6.
- C. Fed. Spec. WC596, W-S-896

1.3 SUBMITTALS

- A. Mark up a complete copy of the specification section for the product to indicate a) acknowledgement of the specification requirement (Comply), or b) acknowledgement that the particular specification requirement does not apply to this specific project (Not Applicable) or, c) acknowledgement that the specification requirement cannot be made or that a variance is being submitted for review to the Architect/Engineer/Owner (Does Not Comply, Explanation:.) Do not submit an outline form of compliance, submit a complete copy of the specification section with the product data.
- B. Submit a sample of each style and color of 120-Volt duplex receptacle and each 120/277-Volt switch with related cover plate. Attach plate to wiring device and label back side of plate with job description with permanent black marker.
- C. Submit manufacturer's product data sheet for each style of device and plate on the project.
- D. Submit drawings of plans, elevation and sections of receptacles and outlets in casework, cabinetwork and built-in place furniture. Coordinate dimensions with millwork shop drawings and related architectural drawing series.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Toggle switches, straight blade and twist lock devices, interior cover plates. Devices with manufacturer provided pig tails or plug-in pig tail are prohibited:
 - 1. Leviton
 - 2. Hubbell
 - 3. Pass and Seymour
- B. Dimming
 - 1. Leviton

2. Lutron

2.2 WIRING DEVICE COLOR

- A. Device color shall be gray except 20A, 125V receptacles and toggle wall switches which are directly supplied from an emergency source and located in mechanical, electrical, or technology rooms shall be red, and heavy duty 30 Amp and larger simplex devices which shall be black in color where the building standard color is not available. All wiring devices supplied from an emergency source located in other than mechanical, electrical, or technology rooms shall be gray.
- B. Provide equivalent hospital grade devices where red is not available in grade specified. Verify with Owner / Architect prior to submitting for approval. Color change kits as required for dimming switches. Low voltage lighting control devices specified elsewhere shall match the line voltage wiring device color specified in this section.

2.3 RECEPTACLES

- A. Industrial grade tamper resistant smooth face duplex receptacles, 2 pole, 3 wire grounding, with ground connection and poles internally connected to mounting yoke, with metal mounting straps, back and side wired with screw type terminals, NEMA indicated, (X=color designation).
 - 1. 20A, 125V duplex NEMA #5-20R: Leviton #5362-SGX
 - 2. 20A, 125V isolated ground duplex NEMA #5-20R: Leviton #5362-IGX
 - 3. 20A, 125V ground fault circuit interruption (GFCI) NEMA #5-20R weather and tamper resistant: Leviton #G5362-WTX
 - 4. 20A, 125V weather resistant (WR), tamper resistant: Leviton #TWR20-GY
 - 5. 20A, 125V plug load control, split circuit marked for "controlled", tamper resistant: Leviton #TDR20-S1G
 - 6. 15A, with 20A feed-through, NEMA #5-15R, 125V duplex, arc fault (AFCI), tamper resistant: Leviton #AFTR1-HGX
- B. Heavy-Duty Simplex: Single heavy-duty type receptacles, with green hexagonal equipment ground screw, with metal mounting straps, back or side wiring, black molded phenolic compound.
 - 1. 15-60A, 125-250V, straight blade, NEMA configuration as indicated or as required by Owner.
 - 2. 15-50A, 125-480V, twist lock, NEMA configuration as indicated or as required by Owner.
- C. Hospital grade receptacles, 2 pole, 3 wire grounding, with ground connection and poles internally connected to mounting yoke, with metal mount straps, back and side wired with screw type terminals, molded phenolic compound, NEMA configuration indicated. Hospital grand devices are required for all audio/visual system equipment outlets, refer to Specification Section 27 41 00 Performance and Broadcast Audio/Video Systems for more information.
 - 1. 20A, 125V grounded duplex NEMA #5-20R: Leviton #8300-X
 - 2. 20A, 125V isolated ground duplex NEMA #5-20R: Leviton #8300-LIG (Orange color devices)
 - 3. 20A, 125V ground fault circuit interruption (GFCI) with indicator light: Leviton NEMA 5-20R-8898-HGX
 - 4. 20A/125V Tamper Resistant Duplex NEMA 5-20R: Leviton 8300-SGX

2.4 WALL SWITCHES

- A. Toggle: Industrial grade flush toggle switches, with mounting yoke insulated from mechanism, equipped with plaster ears, switch handle, back and side-wired screw terminals.
 - 1. Single-pole, 120/277V, 20A switch: Leviton #1221-2X
 - 2. Double pole 120/277V, 20A switch: Leviton #1222-2X
 - 3. Three-way, 120/277V, 20A switch: Leviton #1223-2X
 - 4. Four-way, 120/277V, 20A switch: Leviton #1224-2G
 - 5. Pilot light single-pole, 120/277V, 20A switch: Leviton #1221-PL
 - 6. Momentary, 120/277V, 20A, single-pole double throw, center off: Hubbell only, #HBL 1557G

- B. Toggle key operated switch (verify manufacture and key type with Owner prior to construction).
 - 1. Single-pole, 120/277V, 20A key operated switch: Hubbell HBL #1221GY
 - 2. Two-pole, 120/277, 20A key operated, Hubbell HBL #1222GY
 - 3. Three-way, 120/277V, 20A key operated switch: Hubbell HBL #1223GY
 - 4. Four-way, 120/277V, 20A key operated switch: Hubbell HBL #1224GY
 - 5. Momentary, single pole double throw, center off, 20A key switch: Hubbell #HBL 1557LG
 - 6. Key: Hubbell #HBL 1209. Key switches shall be keyed alike to match the Owner's standard key system. Coordinate with Owner.

- C. Spring wound 12 hours countdown timer switch with hold.
 - 1. Spring wound, 120/277V, 20A, 12Hours max, with hold: Intermatic FF12HHC

2.5 WALL DIMMERS

- A. Wall Box Dimmers: Self-contained, wall box mounted, linear slide square law dimmers with ON/OFF switch. Dimmers shall operate continuously at rated load in an ambient temperature up to 40°C and an input of 100 to 277V. Heat sink fins may be removed only as approved by Owner / Engineer for narrow ganging after applying de-rating.
 - 1. Single-pole, 120/277V, 1000/2308 Watt incandescent / magnetic low voltage: Leviton #AWSMT-MBW.
 - 2. Single-pole, 120/277V, 1500/3463 Watt incandescent / magnetic low voltage, 2-gang heat sink: Leviton #AWSMT-MCW.
 - 3. Single-pole, 120/277V, 1920/4432-Watt LED / fluorescent 0-10V dc, 75 mA current sink: Leviton #AWSMT-7DW.
 - 4. Three, four- or five-way remote switch: Leviton #AWSRT-00W.
 - 5. Color change kit as required.

2.6 GFCI – GROUND FAULT CIRCUIT INTERRUPTER, BLANK FACE

- A. 20A, 125V, GFCI, switch rated, blank face feed through, Hubbell #GFBF20GYL, gray finish, stainless steel cover plate black laser engraved with device protected, (example: VENDING MACHINE GFCI).

2.7 INTERIOR WALL COVER PLATES AND FASTENERS

- A. Type 302 non-magnetic stainless-steel with satin finish (also required for wall box device cover plates for low voltage and digital lighting controls specified elsewhere).

- B. Cover plate laser plate engraving for device identification (other than low voltage lighting controls).
 - 1. Provide laser cover plate engraving with black filling for all wiring devices indicating panelboard name, circuit, and voltage.

2. Wiring devices connected to emergency/stand-by generator or inverter shall include the word "EMERGENCY" in black.
3. Text orientation shall be upright, readable from left to right when cover plate is installed.
4. Remotely located lighting switches shall also indicate the room or area and zone controlled by each switch. Coordinate specific wording with Owner/Architect.
5. Blank face GFCI cover plates shall also intuitively indicate the load or equipment served, device, or area protected downstream ("RM RECEPPTS", "HOOD RECEPPTS", "VENDING", "REFRIG", etc.) For other loads, Owner/Architect shall determine name plate wording.

2.8 EXTERIOR COVER PLATES

- A. Thomas & Betts CK Series, cast aluminum standard depth, locking mount, while-in-use, wet location, universal configuration.
 1. Vertical mount receptacle: #CKSUV
 2. Horizontal mount receptacle: #CKMU
 3. Two-gang: #2CKU
 4. 30-60 Amp Devices: #CKLSUV

2.9 CORD REELS AND DROP CORDS

- A. Cord Reels:
 1. Lighted cord reels: Industrial grade, LED hand Lamp only, 125V, 45-foot 16/3 SJO cord, white finish, LED hand lamp. Hubbell #HBLI45163LED with #HBL340PB pivot base.
 2. 20 Amp (2) duplex receptacle cord reels: Industrial grade, 125V, (2) 20A duplex receptacles, GFCI protection, 45-foot 12/3 SJO cord, white finish, yellow outlet box. Hubbell #HBLI45123GF220 with #HBLI340PB pivot base.
 3. 30 Amp receptacle cord reels: Industrial grade, 125/250V, 30A, 45-foot 10/4 SJO cord, white finish, yellow outlet box. Hubbell #HBLI45104 with #HBLI340PB pivot base. 30 Amp NEMA receptacle termination as required by Owner.
 4. 50 Amp receptacle cord reels: Industrial grade, NEMA 4 wet location, 600V, 55A, 50-foot 6/4 SOOW cord, yellow finish, self-retracting, with NEMA 50-Amp maximum receptacle termination as required by Owner. KH-Industries RTMH4L-WW-K6K.
 5. Recessed enclosure for 20 and 30-Amp cord reels recessed above T-grid drop ceilings: Hubbell #HBLIPRBOX recessed cord reel enclosure, white finish, plenum rated.
- B. Drop cord receptacles:
 1. 20A, 125V, 25-feet 600 VAC, 3-conductor 12 AWG SOOW cable, twist lock plug, two 125V, 20A duplex WR GFCI outlets, safety yellow rubber outlet box, mesh strain relief cord grips. KH Industries #PP4DD-520-B12F-520.
 2. 20A, 125/250V, 25-feet 600 VAC, 4-conductor 12AWG SOOW cable, twist lock plug, four 125/250V NEMA L1420P outlets, safety yellow rubber outlet box, mesh strain relief cord grips. KH Industries #PP7DD-520-B12F-L1420.
 3. 30-60 Amp, voltage, NEMA plug/receptacle as required by Owner, SOOW cable, number of conductors and length as required, mesh strain relief cord grips.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Cover plates for receptacles and toggle switches shall be of the same manufacturer

throughout unless otherwise noted.

1. Key switches and keys shall be as specified and also as approved by Owner.
 2. Submit samples for each specified toggle switch and duplex receptacle color to Architect.
- B. Install wiring devices where shown and as required, in accordance with manufacturer's written instructions, requirements of NEC, and in accordance with industry practices. Do not install devices until wall construction and wiring is completed.
- C. Install receptacles and switches only in electrical boxes that are clean, free from building materials, debris, and similar matter.
- D. Install wiring devices plumb and aligned in the plane of the wall, floor, ceiling or equipment rack.
- E. Install switches in boxes on the strike side of doors as hung. Install so the up position will close the circuit or will be the highest level of illumination. Where more than one switch is in the same location, install switches in a multi-gang box with a single cover plate.
- F. Provide a cover plate for every wiring device and blank cover plates for unused rough-in-only boxes that matches the building standard. Fasten all plates outdoors with type 302 Allen Head "tamper-proof" screws.
- G. Mounting heights of all wiring devices shall comply with local accessibility standards and local codes, except where wiring devices are indicated for special purpose and access is only required by maintenance or service personnel.
- H. Refer to Architectural drawing and elevations, etc. for exact location of wiring devices. Coordinate location of all wiring devices with other trades, specialty items, and millwork and resolve all conflicts prior to rough-in. Field coordinate exact mounting location with all trades to avoid and resolve conflicts during construction.
- I. Locate receptacles for electric drinking fountains/coolers and bottle fill stations below equipment so that the receptacle is accessible and concealed as much as practical from public view by the equipment open cowling so that the receptacle remain readily accessible. For dual level basin equipment, locate receptacle under the upper basin.
- J. Provide convenience outlet receptacle within 25-feet of all new electrically operated mechanical equipment.
- K. Where exterior receptacles are intended for continuous use, mount in horizontal position with while in use cover plate. (Exterior electric drinking fountains, ice makers, ice storage bins, landscape lighting low voltage transformers, seasonal decorative lighting, etc.)
- L. Install wall box dimmers to achieve full rating specified after de-rating for ganging as recommended by manufacturer.
- M. Do not share neutral conductor on load side of dimming switches.
- N. Install receptacles with grounding pole down, or as directed by Owner only for equipment with a corded plug that requires a different orientation (i.e., flat plug assembly), to ensure cord remains plugged and cord hangs down tight against wall. If installed horizontally, install with neutral pole on top.
- O. Connect wiring device grounding terminal to branch circuit equipment grounding conductor.

- P. Provide field installed pigtail to each receptacle and each switch. Neutral and phase conductors shall be installed using side or rear entry lugs only. Do not wrap conductors around screw terminals. Tighten all screws and lugs as recommended by the manufacturer.
- Q. All receptacles and switches shall have a minimum of two wraps of Scotch 33 or equivalent tape around terminal screws.
- R. Provide toggle switch within sight of all trap primers, circulation pumps, 120-Volt motors and motorized equipment to serve as the equipment disconnect switch.
- S. Mount cord reels and cord reel recessed enclosures to structure with galvanized steel struts and as recommended by manufacturer. Field verify exact location of cord reels with Owner/Architect. Mounting location shall avoid conflicts with piping, light fixtures and ductwork, etc. when cord reel is extended and retracted. Set ball stop as directed by Owner / Architect. Provide hand lamp only type cord reels in commercial / educational automotive garages with classified (hazardous) locations. Provide local toggle switch at standard switch height for hand lamp only cord reels.
- T. Mount drop cord suspension hook or j-box to structure to support the cord's weight and additional normal use pulling tension and as recommended by manufacturer. Use cable grips, either with cord grip hanging hook at open ceilings or with chrome plated escutcheon cover plate mounted to recessed j-box at finished ceilings. Field verify exact location, drop height, and NEMA outlet configuration of drop cords with Owner/Architect. Provide weatherproof receptacle cap or covers if located in wet location. Mounting location shall avoid conflicts with piping, light fixtures and ductwork, etc.

3.2 GROUND FAULT PROTECTION FOR PERSONELL

- A. When GFCI personnel protection receptacles are not commercially available or cannot be installed at a readily accessible location or indicated otherwise on the drawings, GFCI personnel protection shall be provided by a remote blank face GFCI wiring device or by an up-stream GFCI receptacle that also provides downstream GFCI protection and located in a readily accessible location. When branch circuit breaker device with integral GFCI protection is required or specified, it shall be within the manufacture's recommended distance limitations of the connected receptacle(s) or load(s) for proper GFCI personnel protection at the farthest outlet.
- B. GFCI personal protection locations include but are not limited to the following:
 - 1. For other than dwelling units: All single phase 125-250-Volt (150-Volts to ground or less) receptacles 50-Amperes or less, and all three phase 125-250-Volt (150-Volts to ground or less) receptacles 100-Ampres or less in the locations indicated below.
 - 2. Dwelling units: All single phase 125-250-Volt receptacles installed in the following locations indicated below.
 - 3. Provide personnel GFCI protection as indicated above in the following locations and all additional locations as required by the NEC.
 - a. Outdoors (with exceptions for not readily accessible receptacles with dedicated branch circuits for snow melting, deicing, pipeline/vessel heat receptacles. Provide these loads with 30mA EGFI circuit breaker protection).
 - b. Bathrooms/toilets/restrooms
 - c. Janitors/custodial closets and mop sinks.
 - d. Laundry areas

- e. Parking structures, service garages, garages and accessory buildings
 - f. Basements, crawl spaces (including 120-Volt lighting)
 - g. Within 6-feet of all water sources including sinks, mop-sinks, lavatories, bathtubs, shower stalls, faucets, eye wash stations, emergency shower stations
 - h. Indoor damp and wet locations
 - i. Locker rooms
 - j. Indoor swimming pools and natatoriums areas and adjacent corridor/hall convenience receptacle outlets located within 25-feet of all access doors.
 - k. Non-dwelling unit therapeutic tubs/pools/whirlpool areas and adjacent corridor/hall convenience receptacle outlets located within 25-feet of all access doors.
 - l. Receptacles serving dwelling unit kitchen counter tops
 - m. Vending machines
 - n. Elevators, dumb waiters, escalators, moving sidewalks: receptacles in pits, hoist ways, well ways or those mounted on the cars of elevators and dumb waiters.
 - o. Electric vehicle charging equipment.
 - p. All receptacles serving kitchen or food preparation counter tops.
 - q. Automotive vacuum machines
 - r. Drinking water fountains/coolers and bottle fill stations
 - s. Corded high-pressure spray washing machines
 - t. Tire inflation machines
 - u. Dish washers
 - v. Receptacles at end of cord reels or drop cords.
 - w. Boat houses, boat hoist, and all pier/dock receptacles and lighting (excludes shore power that requires GFPE).
 - x. Central plant, mechanical rooms and electrical rooms
 - y. Wood, metal, or other material fabrication or vocational training shops.
 - z. Receptacles that serve educational science and science prep room counter tops.
- C. Where a GFCI protected receptacle outlet is required or indicated behind vending machine, refrigerators or other equipment, provide remote GFCI blank face in same room as protected receptacle and at a readily accessible location with standard receptacle outlet behind equipment. Refrigerators shall be GFCI protected only where located within 6-feet of power cord distance from the edge of a sink to the surface of the refrigerator.
- D. Unless indicated otherwise, locate blank face GFCI device near light switches at same height as light switches or ganged with the light switch. Provide GFCI protection for all receptacle outlets located below 42-inches in all infant through 2-year old day care and similar areas designated for occupancy by infant through 2-year old day care occupants so the GFCI device can easily be intentionally tripped or tested and reset.
- E. Provide branch circuit breaker 30mA (EDP) or 100mA (EPE) equipment protection for utilization equipment as required by the NEC and where indicated on the drawings.

3.3 PERFORMANCE AND BROADCAST AUDIO VISUAL SYSTEMS RECEPTACLES

- A. All 125-Volt receptacles providing power to A/V systems from dedicated A/V power transformers shall be hospital grade, isolated ground type receptacles. The isolated ground conductor connection shall be in addition to the solid green raceway/box grounding conductor.

3.4 TESTING

- A. Before energizing, check for continuity of circuits, short circuits, and grounding connections.
- B. After energizing, check wiring devices to demonstrate proper operation and receptacles for correct polarization, voltage and phase orientation if intended 3-phase equipment is phase orientation dependent for proper motor rotation or operation.
- C. Test each individual GFCI receptacle and all downstream receptacles protected by an upstream GFCI device with simulated ground fault tester, make corrections as necessary.
- D. Operate each wall switch with circuit energized and verify proper operation.

3.5 ATTIC STOCK

- A. For each type of wiring device cover plate requiring the word "EMERGENCY", provide attic stock of 20 cover plates of each type (simplex, duplex, triplex, etc.).

END OF SECTION

**SECTION 26 32 13 - NATURAL GAS STANDBY GENERATOR SETS
and TRANSFER SWITCH**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The Conditions of the Contract and applicable requirements of Division 1 and Section 26 05 00 govern this Section.

1.2 WORK INCLUDED

- A. Furnish and install standby engine-driven generator system, complete with wiring and controls as shown on the drawings and as specified herein.
- B. The standby emergency system shall consist of an engine-driven generator set designed and sized for project site ambient conditions and project site altitude, complete for outdoor installation where specified or required outdoors, automatic transfer switches and associated fuel system.

1.3 QUALITY ASSURANCE

- A. Acceptable Manufacturers:
 - 1. Engine-Driven Generator Sets:
 - a. Cummins
 - b. Caterpillar
 - c. Kohler
 - 2. Automatic Transfer Switch.
 - a. Cummins
 - b. Russelectric
 - c. ASCO
 - d. Zenith
 - e. Kohler
 - f. Standby electric generating system manufacturer (as an integral part of a complete system).
- B. NEC and NFPA Compliance: Comply with applicable portions of the NEC (NFPA 70) including, but not limited to, emergency and standby power generation systems (NFPA 99 & 110), and with NFPA 37 Installation and Use of Stationary Combustion Engines and Gas Turbines.
- C. IEEE Compliance: Comply with applicable Institute of Electrical and Electronics Engineers, Inc. (IEEE) standards pertaining to generator construction.
- D. EPA Compliance: Comply with all EPA Standards for permanently installed natural gas emergency generators.
- E. Testing: The generator set shall receive the manufacturer's standard factory load testing.
- F. Supplier: All equipment provided shall be supplied by an authorized distributor of the manufacturer who has been continuously engaged in the distribution of industrial grade Power System products for a minimum of 15 years. The supplier shall provide initial start-up services, conduct field acceptance testing, and warranty service. The

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supplier is to be authorized to perform warranty service on all products provided. Within 50 miles of the job site, the supplier shall maintain; a minimum of 6 factory-trained and qualified field technicians; a proper supply of spare parts for the supplied equipment; a shop with overhaul capabilities; and be able to provide 24 hour, 7 day per week, 365 day per year field service capability.

1.4 SUBMITTALS

- A. Submit manufacturer's certified computer-generated performance and capacity data in accordance with specification requirements. Indicate and include all ambient and altitude de-ratings and calculations.
- B. Submittal drawings and information on the transfer switches including installation drawings, wiring diagrams, dimensions, weights, etc. shall be provided. Full descriptive information on accessory items shall be furnished.
- C. Submit manufacturers' "Installation, Start-Up and Service" instructions, recommended conductors, overcurrent protection, and electrical interlocks.
- D. Submit recommended clearance dimensions.
- E. Submit sequence of operation in narrative form.
- F. Instruction Data and Drawings: Commercial type operating instructions shall be provided consisting of operating and maintenance manuals, parts books, dimensional drawings and wiring diagrams.

1.5 WARRANTY

- A. Provide five-year parts and labor warranty from date of substantial completion for generator set(s) and transfer switch(es).

PART 2 - PRODUCTS

2.1 ENGINE-GENERATOR SETS

- A. The engine-generator set shall be furnished as a complete working system. The model provided shall be a standard model that is quality assurance tested and prototype tested, not one of a kind without supporting literature.
- B. Engine shall be liquid cooled, reciprocating engine, 12V DC electric start, natural gas fueled, electronic isochronous governed with manual speed adjustment plus/minus 5%, with belt-driven battery charging alternator.
- C. The set shall provide the following performance:
 - 1. Rated power for the duration of any utility power outage, in ambient conditions to 500-feet altitude and an outside air ambient temperature of 10 degrees F to 110 degrees F. Liquid coolant system ratings for natural gas sets through 140KW shall be rated at 122 degrees F ambient.
 - 2. Start and accept rated load within 10 seconds of utility power outage.
 - 3. Voltage regulation of plus/minus 2% no load to full load with random voltage variation, at any constant load, less than plus/minus 1%.
 - 4. Isochronous frequency regulation, less than plus/minus 0.5% at any steady state load from no load to full load.

- D. Engine Coupling: Engine shall be directly connected to the generator through a suitable flexible coupling.
- E. Generator:
1. The generator shall be a standard make, 4-pole, revolving field, single bearing, synchronous, brushless type with the following characteristics:
 - a. Capacity as shown on the drawings and shall operate at 1800 rpm.
 - b. Dripproof, self-ventilating, permanently aligned and complete with rotating brushless exciter and shall be of ball bearing construction and connected to the engine with flexible disc coupling.
 - c. Conform to the latest applicable IEEE and NEMA standards.
 - d. Provided with generator overload protection or generator manufacturer's overload protective circuitry.
 - e. Output main circuit breaker(s) with adjustable LIS trip for cable protection shall be provided when shown on drawings. Circuit breaker manufacturer shall be the same as switchgear manufacturers specified and submitted to be used on this project.
 - f. Voltage Regulator: Include a full wave rectified automatic digital voltage regulation system matched and prototype tested by the engine manufacturer with the governing system provided. It shall be immune from mis-operation due to load-induced voltage waveform distortion and provide a pulse width modulated output to the alternator exciter. The voltage regulation system shall be equipped with three-phase RMS sensing and shall control buildup of AC generator voltage to provide a linear rise and limit overshoot. The system shall include a torque-matching characteristic, which shall reduce output voltage in proportion to frequency below an adjustable frequency threshold. Torque matching characteristic shall be adjustable for roll-off frequency and rate, and be capable of being curve-matched to the engine torque curve with adjustments in the field.
 - g. Alternator: The generator shall be capable of withstanding a three phase load of 300% rated current for 10 seconds, and sustaining 150% of continuous load current for 2 minutes with field set for normal rated load excitation.
 2. Provide the generator with the following:
 - a. Minimum 130°C rise stand-by rating
 - b. NEMA Class F or H insulation as defined by NEMA MG1.65
 - c. Temperature rise by resistance and embedded detector measurements at rated load within NEMA MG1-22.40 definition.
 - d. Pre-lubricated, maintenance free ball bearing, lubricated for life.
 - e. Direct drive centrifugal blower cooling.
 - f. RFI filters on the exciter to eliminate radio frequency interference on electronic equipment.
 - g. Thermostatically controlled block strip heater mounted for condensation control.
- F. Sub-Base: The engine power plant shall be mounted on an I beam, box type sub-base of fabricated steel construction. The assembly shall be installed on a vibration-absorbing base on a concrete pad as shown on the drawings.
- G. Automatic Starting Sequence of Events:
1. Upon drop in normal source voltage to 65 to 70% of rated voltage, or upon failure of the normal source of electrical supply, the engine shall be

- automatically cranked and brought up to the full operating speed.
2. The cranking motor circuit shall be instantly broken when the engine starts.
 3. Within 10 seconds the generator shall be brought up to operating speed; the generator voltage shall operate the automatic transfer switch, disconnecting the load from the normal source of supply and connecting the emergency power to the load.
 4. Upon restoration of the normal source voltage to 92 to 95% of rated voltage or restoration of normal source of supply, the sequence shall be reversed, restoring the transfer switch to the automatic normal operating position, disconnecting the load from the emergency generator and reconnecting the load to the normal source of supply. The emergency generator set will continue to operate for a period of from 1 to 5 minutes after the restoration of the normal source of supply. Should the engine fail to start upon the first crank, there shall be two additional cranking attempts made with a 15 second rest between cranks, after which the cranking cycle shall cease and an alarm shall sound to indicate malfunctioning of the system.
 5. The controls shall automatically stop the engine in the event the cooling water temperature becomes too high, if the coolant level becomes too low, if the oil pressure drops below a pre-determined pressure, or if the engine overspeeds. Upon the failure of the engine for any of the above reasons, an indicating lamp will operate indicating the condition under which the engine was shut down. Also, the alarm signal shall be energized.

H. Engine Control Panel & Accessories:

1. Provide a comprehensive monitoring and control system integral to the Generator Set control to guard the electrical integrity of the alternator and power system. Provide single and 3-phase fault current regulation, so that downstream protective devices have the maximum current available to quickly clear fault conditions, without subjecting the alternator to potentially catastrophic failure conditions. Include provisions to either prevent over voltage due to single phase faults, or to shut down the generator set if line to neutral voltage on any phase exceeds 115% for more than 0.5 seconds. Acceptable methods are a fully rated (100%) 600 volt Circuit Breaker, mounted in the generator enclosure, Schneider Electric - Square D Programmable Micrologic of size as indicated on drawings with handheld programmer or inherent protection provided by microprocessor-based GenSet AmpSentry protection. Submittals shall demonstrate that the protective device provides proper protection for the alternator by a comparison of the trip characteristic of the breaker with the thermal damage characteristic of the alternator. Field circuit breakers shall not be acceptable for generator overcurrent protection. The control system shall actively control the fuel rate and excitation as appropriate to the state of the generator set. Fuel rate shall be regulated as a function of starting, accelerating to start disconnect speed, accelerating to rated speed. The governing system shall include a programmable warm up at idle and cool-down at idle function. While operating in idle state, the control system shall disable the alternator excitation system. An electronic governor system shall provide automatic isochronous frequency regulation. The governing system dynamic capabilities shall be controlled as a function of engine coolant temperature to provide fast, stable operation at varying engine operating temperature conditions. The Control Panel shall include, but is not be limited to, the following instruments and protective devices:
 - a. AC Ammeter.
 - b. Phase Selector Switch.
 - c. Current Transformers.

- d. AC Voltmeter.
 - e. Automatic Solid State Voltage Regulator with immunity to severe induced waveshape distortion from nonlinear leads.
 - f. Rheostat for Adjusting voltage $\pm 5\%$ of Rated Voltage.
 - g. Engine Malfunction Warning Lights/Audible Alarm:
 - 1) Anticipating High Engine Temperature.
 - 2) Anticipatory Low Oil Pressure.
 - 3) Low Fuel.
 - 4) Control Switch not in Automatic Position.
 - 5) Low Water Temperature.
 - 6) Low Oil Pressure.
 - 7) High Water Temperature.
 - 8) Engine Overcrank.
 - 9) Engine Overspeed.
 - h. Frequency Meter.
 - i. Non-resettable Elapsed Time Meter with a 9,999.9 Hour Maximum Indication.
 - j. Coolant Temperature Gauge.
 - k. Oil Pressure Gauge.
 - l. Provisions for Remote Emergency Shutdown.
 - m. Combination alarm shutdown system with manual reset and indicating lights for high engine temperature, low oil pressure, engine overspeed, and engine failed to start. Include an additional set of contacts for remote alarms.
 - n. Manual run/off/automatic selector switch for control of engine with flashing red light, and shall allow manual starting of plant without assuming load.
- 2. Provide low coolant level shutdown, which shall activate high engine temperature lamp and shutdown.
 - 3. Solid-state cranking cycle device preset at 15 second cranking cycle and 15 second rest cycle followed by a 15 second cranking cycle. If engine fails to start after 3 crank cycles and 2 rest cycles, an overcranking alarm shall sound and cranking cycle shall stop. Provide adjustments in accordance with manufacturers recommendations, but cumulative crank-rest timing shall not be less than 75 seconds.
 - 4. In the event of engine failure, the panel shall close alarm circuit, indicate the fault on the appropriate lamp and shut down the engine. The panel shall include a manual reset switch so that the panel can be reset immediately after a fault condition. Reset devices that require a waiting period are not acceptable.
- I. Options and accessories shall include the following:
 - 1. Housing: The complete engine generator set shall be enclosed in a free-standing weather protective, aluminum (0.063-inch) panel construction housing with lockable, removable hinged door panels, hinged instrument panel door and panel light. Housing shall be wind rated to a minimum 150 mph.
 - a. All parts shall be adequately protected against oxidation and corrosion and finish painted with durable machinery enamel, minimum of 3 mils applied in a maximum of 1-1/2 mils per application.
 - b. Include within the enclosure a switched 12 or 24-Volt LED luminaire on each side of the engine and a GFCI receptacle.
 - c. The enclosure must maintain the engine and generator at 40°F or be equipped with space heaters to maintain starting batteries between

- 50°F and 90°F.
2. 12V or 24-volt battery starting with maintenance free lead acid batteries with dual rate solid state automatic battery charger, with equalize timer, low and high battery voltage indicators and alarm terminals, charger malfunction indicator and alarm. Batteries shall be capable of providing two 45 second continuous cranking cycles. Provide battery racks, and charger shall be protected from any other charging source.
 3. Muffler, critical silencing, with condensation drain; stainless steel flexible exhaust connector. Silencer shall mount horizontally on structural support inside of housing with 90° elbow termination with rain cap.
 4. Premium exhaust rain cap, cast aluminum, stainless steel hardware, brass bushing hinge.
 5. Gas line accessories as required for the set to include but not limited to gas line strainer, 12" braided metallic flexible fuel line, battery power operated gas line shut-off solenoid valve, pressure reducing regulator fuel pressure gauge.
 - a. Contractor shall provide natural gas fuel piping for the emergency generator set. Contractor shall install natural gas line fittings obtained from electrical contractor (as supplied with the engine generator). Plumbing line work for natural gas for the engine generator shall be with as few elbows and bends as possible (as near a straight line run from the gas supply tee-off as possible).
 6. Coolant heater, 120VAC, 1 phase, 1000-2500 watts.
 7. Unit mounted emergency shut-off mushroom type pushbutton switch.
- J. Testing: The unit shall be given a complete shop test before shipment. It shall be installed on the job under supervision of the manufacturer's representative and shall receive start-up / commissioning service from that representative.
1. The unit shall be started cold and run for a one-hour test with building load connected. Provide additional load bank as required to achieve 100 percent loading.
 2. Retransfer the load after test.
 3. After this test, the set shall cool for five minutes, then must start and carry full building load for four hours.
 4. Demonstrate the cranking cycle and all engine safety devices. The Owner's authorized representative shall be instructed in the operation and maintenance of the unit.
- K. Instruction Data and Drawings: Commercial type operating instructions shall be provided consisting of operating and maintenance manuals, parts books, dimensional drawings and wiring diagrams. Three copies of dimensional drawings and wiring diagrams shall be provided as specified.
1. Operating Instructions: Provide and install in a suitable enclosure operating instructions for the engine generator set.
 2. Contractor shall fill the radiator with a combination of water and ethylene-glycol to protect the radiator to -20°F after completion of the test.

2.2 AUTOMATIC TRANSFER SWITCHES

- A. Rating and Construction:
1. Refer to the project drawings for specifications on the sizes and types of transfer switch equipment, withstand and closing ratings, voltage and ampere ratings, enclosures and accessories. All transfer switches shall have switched neutrals and shall be electrically operated and mechanically held.
 2. Bypass isolation not required.

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3. All transfer switches and accessories shall be UL listed and labeled, tested per UL Standard 1008, and CSA Approved, and comply with NEMA ICS 2-447. When protected by molded case breaker withstand and closing ratings shall not be less than the following RMS symmetrical amps at 600 VAC:

| Switch Size in Amps | WCR @ 480 Volts |
|---------------------|-----------------|
| Up to 260 | 30,000 |
| 300 to 1000 | 65,000 |
| 1200 | 85,000 |
| 1600 and larger | 100,000 |

4. Provide one of the following standard products:
 - a. Onan OTPC Series as required
 - b. Standby Generator System Manufacturer, provided as a complete system
 - c. ASCO 300 Series
 - d. Russelectric RMT/RMTD Series
 - e. Zenith ZTSD Series
5. Electrical operation shall be accomplished by a momentarily energized single solenoid operating mechanism which receives power from the source to which the load is being transferred. Fuse or thermal protection of the main operator is prohibited. The operating transfer time shall be 1/6 of a second or less. Mechanical locking in each position shall be accomplished without the aid of permanent magnets, latching solenoid, or motor operators.
6. Operation shall be inherently double-throw whereby all contacts move simultaneously and with no programmed delay in a neutral position. Electrical spacing shall be equal to or exceed those listed in table 15.1 of UL 1008. Only those main contact structures specifically manufactured for transfer switch service shall be acceptable. An overload or short circuit shall not cause the switch to go to a neutral position.
7. Inspection of all contacts (movable and stationary) shall be possible from the front of the switch without disassembly of operating linkages and without disconnection of power conductors. A manual operating handle shall be provided for maintenance purposes. The maintenance handle shall permit the operator to stop the contacts at any point throughout the entire travel to properly inspect and service the contacts when required.
8. All switches for systems with switched neutrals shall have fully rated neutral transfer contacts that momentarily interconnect the neutrals of the sources and load for 100 milliseconds maximum, during the transfer/retransfer operation. The neutrals shall remain so interconnected until the line contacts close on the alternate source. Line and neutral contacts shall be driven by a single main operator.

B. Controls and Accessories:

1. Controls shall provide for the automatic starting sequence of the generator set.
2. Automatic controls shall signal the engine-generator set to start upon signal from normal source sensors. Solid state time delay start, adjustable from 0 to 5 seconds (factory set at 2 seconds) shall avoid nuisance start-ups. Battery voltage starting contacts shall be gold, dry type contacts factory wired to a field wiring terminal block.
3. The switch shall transfer when the emergency source reaches the set point voltage and frequency. Provide a solid-state time delay on transfer, adjustable from 0 to 120 seconds.
4. The switch shall retransfer the load to the normal source after a time delay retransfer, adjustable from 0 to 30 minutes. Retransfer time delay shall be

- immediately bypassed if the emergency power source fails.
5. Control shall be solid state and designed for a high level of immunity to power line surges and transients, demonstrated by test to IEEE Standard 587-1980. The control shall have optically isolated logic inputs, high isolation transformers for AC inputs, and relays on all outputs. Control shall be quick disconnect for ease of service.
 6. Automatic transfer switches shall have inherent phase balance protection logic to detect a 'single phasing' Solid state undervoltage sensors shall simultaneously monitor all phases of both sources. Pick-up and dropout settings shall be adjustable. Voltage sensors shall allow for adjustment to sense partial loss of voltage on any phase. Voltage sensors shall have field calibration of actual supply voltage to nominal system voltage. The transfer switch controller shall be equipped with a fault output terminal interconnected to a 24Vdc shunt trip, integral to the transfer switch and with built-in time delay, that functions to disconnect the utility source from the load should the standby emergency source fail to start.
 7. For transfer switches serving non-disconnected motor loads, equip with a field adjustable time delay during switching in both directions, during which time the load is isolated from both power sources, to allow load residual voltage to decay before closure to the opposite source. The delay feature shall have an adjustable range covering 0 to 7.5 seconds. Transfer switches serving life safety equipment shall have this time delay set at 0 at startup/commissioning.
 8. Controls shall signal the engine-generator set to stop after a time delay, adjustable from 0 to 10 minutes, beginning on return to the normal source.
 9. Power for transfer operation shall be from the source to which the load is being transferred.
 10. The control shall include latching diagnostic indicators to pinpoint the last successful step in the sequence of control functions, and to indicate the present status of the control functions in real time.
 11. The control shall include provisions for remote transfer inhibit and area protection.
 12. Provide front panel devices mounted on cabinet front consisting of:
 - a. A key operated selector switch to provide the following positions and functions:
 - 1) Test - Simulates normal power loss to control for testing of generator set. Refer to Part 3 for programming requirements.
 - 2) Normal - Normal operating position.
 - 3) Retransfer - Momentary position to override retransfer time delay and cause immediate return to normal source, if available.
 13. Exerciser Clock: Provide solid state exerciser clock to set the day, time, and duration of generator set exercise/test period. Provide a with/without load selector switch for the exercise period. Refer to Part 3 for programming requirements.
 14. Provide Phase Sequence Monitor/Balance Module to protect against inadvertent phase rotation hookup and monitor for voltage phase imbalance between phases.
 15. Each transfer switch shall be provided with a control panel to allow the operator to view the status and control operation of the transfer switch. The control panel shall be a sealed membrane panel rated NEMA 3R/IP53 or better (regardless of enclosure rating) that is permanently labeled for switch and control functions. The control panel shall communicate with the engine generator, including display of all engine and alternator data, and other transfer switch data in the power system. The control panel shall allow

starting and stopping of the generator set via the transfer switch control panel in both test and emergency modes.

16. Where elevator loads or load disconnect of motor controls are shown on the plans, provide in switches serving elevators or motors the following:
 - a. Signal module to delay the transfer and retransfer of the switch for up to 50 seconds to provide a pre-transfer warning or load disconnect signal contact. Provide signals for the following conditions:
 - source 1 available
 - source 2 available
 - test/exercise
 - backup source available
 Contacts for these functions are to be Form C type, rated for 120 VAC or 30 VDC at 4 amps.

2.3 REMOTE ANNUNCIATION PANEL

- A. Locate next to ATS. Provide flush mounted with stainless steel plate containing the following:
 1. Trouble sonnet horn with silence switch.
 2. Illuminated annunciators with nameplates in accordance with the following table:

| Lamp Legend | Generator Set Condition Indicated | Light | Audible Alarm |
|-----------------------------|--|--------------|---------------|
| High Battery Voltage | Battery charger too high | Red | No |
| Low Battery Voltage | Battery voltage too low | Red | No |
| Normal Battery Voltage | Battery voltage ok | Green | No |
| Generator Running | Generator has output voltage | Green | No |
| Normal Utility Power | Utility power supplying the load | Green | No |
| EPS Supplying Load | Genset supplying the load | Green | No |
| Pre-Low Oil Pressure | Oil pressure approaching low limit | Yellow | Yes |
| Low Oil Pressure | Engine has shut down due to low oil pressure | Red | Yes |
| Pre-High Coolant Temp. | Temperature of coolant approaching high limit | Yellow | Yes |
| High Coolant Temp. | Genset has shut down due to high coolant temp. | Red | Yes |
| Low Engine Temp. | Engine heater has malfunctioned | Red | Yes |
| Overspeed | Engine has shut down due to overspeed | Red | Yes |
| Overcrank | Engine failed to start | Red | Yes |
| Not In Auto | Engine control switch not in AUTO position | Flashing Red | Yes |
| Battery Charger Malfunction | Charger is signaling a failure | Red | Yes |
| Low Fuel | Fuel level below preset minimum | Red | Yes |
| Fault | Customer preselected condition | Red | Yes |

- B. Name plates shall be laminated black with white letters engraved. Letter size shall be a minimum of 3/8" high.
- C. Illuminated annunciators shall be 1 inch minimum.

2.4 ELECTRICAL AND MECHANICAL PERFORMANCE

- A. The switch must comply with UL 1008 and NEMA Standard Publication ICS 2-447. In addition, the switch must meet or exceed the following requirements and if so requested, be verified by certified laboratory test report.
1. Temperature Rise: Measurements shall be made after the overload and the endurance tests.
 2. Withstand: UL listed to withstand the magnitude of fault current available at the switch terminals when coordinated with respective protective devices at an X/R ratio of 6.6 or less. The main contacts of the transfer switch shall not trip open or weld when subjected to fault currents.
 3. Dielectric: Test, following the withstand current rating test, at 1960 volts AC rms minimum.
 4. Transient Withstandability: Control panel voltage surge withstand capability test per IEEE Standard 472-1974 and voltage impulse withstand test per NEMA Standard publication ICS-1-109.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install standby engine driven generator set where shown, in accordance with the equipment manufacturer's written instructions and recognized industry practices, to ensure that the set complies with the specified requirements and serve the intended purposes. Provide and install in a Plexiglas enclosure complete operating instructions for each type of transfer switch.
- B. Standard: Comply with NEMA standards, requirements of the NEC, and applicable portions of NECA Standard of Installation pertaining to installation of standby engine-driven generator sets and accessories.
- C. Vibration Isolation:
1. Outside Mounted: Ribbed Neoprene Vibration Isolation
 2. Roof Mounted: Install units on properly sized spring-type vibration mounts and ribbed Neoprene vibrations isolators.
 3. Generator installed inside building: Install units on properly sized spring-type vibration mounts and ribbed Neoprene vibration isolators.
- D. Concrete Pad: Install generator set on a reinforced concrete pad. The generator pad shall extend 6" beyond the generator set base, unless shown otherwise. Furnish the exact position of any block outs, mounting bolts, and the dimensions and location of the generator pad in a timely manner so as to prevent delay of the concrete work. Refer to Section 26 05 00 for housekeeping pads and Division 3 for Concrete Work.
- E. Options and Accessories: Provide circuits, conductors, and raceways as required for generator options and accessories as required and specified. Provide separate dedicated circuits from the emergency branch circuit panel board to the generator for (1) engine/ coolant heaters, (2) GFCI convenience receptacle(s), (3) battery charger (LED work lights on battery), etc. Provide additional circuits as required, for a fully operational system.
- F. Provide remote alarm annunciator. Coordinate final location of annunciator with Owner / Architect prior to installation. It shall be installed near ATS.

- G. Provide dry contacts and outputs to monitor transfer switch and generator alarm conditions and notify Owner's Police or security personnel, and building management controls system and personnel, both when transfer to emergency occurs and when transfer to normal occurs.
- H. Adjust main output circuit breaker(s) adjustable trip setting based on manufacturer's fault current and coordination analysis or as directed by Engineer.

3.2 GROUNDING

- A. Install the generator as a separately derived system. Ground the generator neutral to the generator frame. Ground the generator frame to the building grounding system and provide a driven ground electrode at the generator location.

3.3 CONTROLS

- A. Provide generator start-up control wiring and raceway from each automatic transfer switch to the respective standby generator set as required.

3.4 TESTING

- A. Notify Owner's Commissioning Authority (CxA) prior to performing any tests so the CxA may witness tests at his/her discretion. Refer to Section 26 01 00 Commissioning of Electrical Systems. Testing shall be witnessed by owner and Engineer.
- B. Provide testing in accordance with NFPA 110. Upon completion of installation of engine-driven generator set and after building circuitry has been energized with normal power source. Provide manufacturer's start-up service to test emergency power system to demonstrate standby capability and compliance with specified requirements, including automatic start-up, controls and full load acceptance. Test shall include operation of standby power system with voltage check while the system is loaded to ensure proper operation of the emergency generator, transfer switches, and other system components. Operation of the system shall simulate standby power conditions, that is, loss of main electrical power to the building. Test period shall be trouble-free operation with at least four automatic transfer switch operations (each switch) within the period of operation.
 - 1. The unit shall be started and run for 30-minute break-in period at no-load unless recommended otherwise by manufacturer.
 - 2. The unit shall be started cold and run for a four-hour test with building load connected and load bank to achieve 90 percent of rated generator capacity. Monitor and record available natural gas pressure and verify supply is adequate and stable during the entire test.
 - 3. Retransfer the load after test.
 - 4. After this test, the set shall cool for five minutes, then must start and carry 90% rated capacity load for four hours.
 - 5. Provide additional Owner witnessed testing for all ancillary equipment on generator. Demonstrate all specified functions and alarms.
 - 6. Demonstrate the cranking cycle and all engine safety devices. The Owner's authorized representative shall be instructed in the operation and maintenance of the unit. Provide minimum 4-hours training at each campus for 4-persons; one hour on four separate days
- C. Contractor shall furnish all instruments, load banks, and personnel required for test. Submit 4 copies of certified test results to Architect/Engineer for review. Test reports

shall include date and time of test, relative humidity, temperature and weather conditions.

3.5 MISCELLANEOUS

- A. Provide circuits and receptacles to serve loads as directed by Owner / Architect, including, but not limited to:.
1. Telecommunications equipment
 2. Public Address Communication & Master Clock System
 3. Fire Detection Alarm and Signaling Systems including remote transponder panels and alarm power supply panels
 4. Security Systems including remote power supplies (except for battery powered access control door hardware)
 5. Video Surveillance CCTV System including remote camera power supplies
 6. All receptacles and outlets in MDF/IDF rooms.
 7. Technology MDF/IDF room dedicated HVAC equipment
 8. Walk-in coolers/freezers and selected reach-in refrigeration equipment
 9. Clinic refrigerator and selected clinic receptacles
 10. Building Access control System including remote power supplies, except do not power door electric strike or hinge hardware on emergency power.
 11. Owner's Radio Base Station and handset charging equipment / Radio Repeaters / Distributive Antennae Systems (DAS)
 12. Elevators, ADA chair/personnel lifts
 13. Point of Sale Stations
 14. Kitchen Manager's Workstation
 15. Building Management and Control System (BMCS)
 16. Special education receptacles, minimum one in each room.
 17. First responder Bi-Directional Distributive Antennae System (DAS) Systems
- B. Mount annunciator alarm as directed by Owner / Architect. Coordinate final location of ATS with Owner / Architect prior to installation. Install next to ATS.

3.6 PROGRAMMING

- A. Program automatic transfer switches for delayed transfer to emergency and sequential operation to transfer loads by priority based on manufacturer recommendation or as indicated below:
1. Life Safety Loads – less than 10 seconds
 2. Critical Loads – more than 15 seconds, less than 30 seconds
 3. Equipment Loads – more than 40 seconds, less than 60 seconds
 4. Non-Legally required loads – more than 75 seconds, less than 120 seconds
- B. Program automatic transfer switch voltage and frequency pick-up and drop out for load shedding based on load priority for voltage and frequency based on manufacturer recommendations or as indicated below:
1. Life Safety pick-up 10%; drop out 20%
 2. Critical Loads pick-up 10%; drop out 15%
 3. Equipment Loads pick-up 8%; drop out 15%
 4. Non-Legally required loads pick-up 5%; drop out 10%
- C. Exerciser clock: Program automatic transfer switch exerciser clock for generator to run every Tuesday, 8:00 AM, for 15-minute run time, without load. Verify with Owner.
- D. Test switch: Program automatic transfer test switch for generator to run with load, for

minimum 30-minutes to comply with NFPA 110 requirements for monthly testing.
Maximum test time shall not exceed 35-minutes unless directed otherwise by Owner.

- E. Program engine cooldown time as recommended by the manufacturer.

3.7 TRAINING

- A. Provide 4 hours training, one hour each for four persons, four separate days.

END OF SECTION

**SECTION 26 32 16 - DUAL PURPOSE MANUAL TRANSFER
SWITCHES WITH INTEGRATED LOAD BANK AND GENERATOR
QUICK CONNECTS**

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish and install manual transfer switches with 4-poles, amperage, voltage, and withstand current ratings as shown on the plans or as required. Each manual transfer shall consist of a 3-position center off mechanically held power transfer switch unit and a mechanical operating mechanism to provide complete manual operation. Each manual transfer switch shall include integrated load bank and generator quick disconnects. All manual transfer switches and mechanical operating mechanism shall be the product of the same manufacturer.

1.2 RELATED DOCUMENTS

- A. The Conditions of the Contract and applicable requirements of Division 1 and Section 26 05 00 govern this Section.

1.3 Acceptable Manufacturers

- A. Basis of design: ASCO Series 300.
- B. Alternate manufactures:
 - 1. Trystar
 - 2. PSI Power and Controls

1.4 Codes and Standards

The manual transfer switches and accessories shall conform to the requirements of:

- A. UL 1008 Listed for Optional Standby Transfer Switches (Manual Transfer Switches)
- B. UL 891 Switch Boards
- C. CSA C22.2 No.178 –1978
- D. EC 60947-6-1 Low – Voltage Switchgear and Controller
- E. PA 70 - National Electrical Code
- F. FPA 99 – Essential Electrical Systems for Health Care Facilities
- G. IEEE Standard 446 - IEEE Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications
- H. UL 508 Industrial Control Equipment
- I. NEC Article 700
- J. International Standards Organization ISO 9001
- K. RoHs compliant (Restriction of Hazardous Substances)

DUAL PURPOSE MANUAL TRANSFER SWITCHES WITH INTEGRATED
LOAD BANK AND GENERATOR QUICK CONNECTS

- L. Seismic qualification – International Building Code & OSHPD to SDS level of 2.5

1.5 QUALITY ASSURANCE

- A. NEC and NFPA Compliance: Comply with applicable portions of the NEC (NFPA 70) including, but not limited to, emergency and standby power generation systems.
- B. IEEE Compliance: Comply with applicable Institute of Electrical and Electronics Engineers, Inc. (IEEE) standards pertaining to generator construction.
- C. Supplier: All equipment provided shall be supplied by an authorized distributor of the manufacturer who has been continuously engaged in the distribution of industrial grade Power System products for a minimum of 10-years. The supplier shall provide initial start-up services, conduct field acceptance testing, and warranty service. The supplier is to be authorized to perform warranty service on all products provided.

1.6 SUBMITTALS

- A. Submittal drawings and information on the manual transfer switches including installation drawings, wiring diagrams, dimensions, weights, etc. shall be provided. Full descriptive information on accessory items shall be furnished. Indicate:
 - 1. Detailed dimensions for equipment footprint, front, rear, and side elevations.
 - 2. Conduit entrance locations and requirements and restrictions.
 - 3. Enclosure material, finish, and NEMA classification type.
 - 4. Nameplate legends.
 - 6. Metering and control wiring details.
 - 7. Electrical characteristics including voltage, ampacity, overcurrent device frame size and trip ratings, withstand ratings, and time current curves of all overcurrent devices and components.
- B. Submit manufacturers' "Installation, Start-Up and Service" instructions, recommended conductors, overcurrent protection, and electrical interlocks.
- C. Submit recommended clearance dimensions.
- D. Submit sequence of operation in narrative form.
- E. Instruction Data and Drawings: Commercial type operating instructions shall be provided consisting of operating and maintenance manuals, parts books, dimensional drawings, and wiring diagrams.

1.7 WARRANTY

- A. Provide one-year parts and labor warranty from date of substantial completion.

PART 2 - PRODUCTS

2.1 Mechanically Held Transfer Switch

- A. The manual transfer switch unit shall be manually operated and mechanically held. The switch shall be mechanically interlocked to ensure only one of three possible positions, Source 1, Source 2, or Center Off. Fused disconnect type switches shall not be acceptable.

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LOAD BANK AND GENERATOR QUICK CONNECTS

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- B. The switch shall be positively locked and unaffected by momentary outages so that contact pressure is maintained at a constant value and temperature rise at the contacts is minimized for maximum reliability and operating life.
- C. All main contacts shall be silver composition. Switches rated 600 amperes and above shall have segmented blow-on construction for high withstand current capability and be protected by separate arcing contacts.
- D. Inspection of all contacts shall be possible from the front of the switch without disassembly of operating linkages and without disconnection of power conductors.
- E. Transfer switch 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.
- F. Neutral conductors shall be switched to electrically isolate the permanent generator from the temporary generator. The manual transfer switch shall be provided with fully- rated neutral transfer contacts.
- G. The manual transfer switch shall be tested in accordance with UL 1008 for transfer switches. Switch ratings of 260 Amperes and less shall have endurance rating of 6000 cycles, 400 Ampere shall have endurance rating of 4000 cycles, and 600 – 3000 Amperes shall have endurance rating of 3000 cycles.

2.2 MANUAL OPERATIONS PROVISIONS

- A. The manual transfer switch shall be arranged for manually actuated manual operation.
- B. The manual transfer shall be actuated via a mechanical operating mechanism.
- C. The manual operating handle shall be capable of external operation without opening the enclosure door.
- D. It shall have the same contact to contact speed as would be for automatic operation.
- E. There shall be three positions for manual operation:
 - 1. Connected to Source 1 (preferred)
 - 2. Connected to Source 2 (alternate)
 - 3. Connected to center off (disconnected position)
- F. Switch position when connected to Source 1, or Source 2 shall be pad – lockable.

2.3 ENCLOSURE

- A. Manual transfer switches located outdoors shall be furnished in a NEMA type 3RX type 316 stainless steel enclosure. Manual transfer switches located indoors shall be NEMA 3R.
- B. Enclosures shall be wall mounted or free-standing floor or pad mounted.
- C. NEMA 3R enclosures shall be code gauge steel as per UL 50 with ANSI #61 powder coat finish.

- D. 3RX enclosures shall be 316 stainless steel.
- E. Provide strip heater with thermostat for Type 3R and 3RX enclosure requirements.

2.4 MECHANICAL AND ELECTRICAL PERFORMANCE

- A. Mechanical position indicators (yellow) visible to the operator shall be included for Source 1 (preferred), Source 2, (alternate), and Center Off (disconnected).
- B. Auxiliary position indicating contacts, rated 10 amps, 250 Vac shall be provided consisting of one closed when the manual transfer switch is connected to Source 1 (preferred), and one contact closed when the manual transfer switch is connected to Source 2 (alternate).
- C. A form A contact shall be provided to indicate switch is in the Center Off (disconnected) position.
- D. A Load Dump disconnect circuit breaker shall be provided between source 1 of the manual transfer switch and the 16 Series Outlets for Load Bank Connection. Load Dump circuit breaker shall include shunt trip and be sized for the full rating of the manual transfer switch and capable of carrying, at minimum, the full kW rating of the permanent generator for a minimum of 4-hours. Provided ground fault (GFI) protection for circuit breakers rated 800 Amperes or larger. Load dump disconnect circuit breaker shall be Square D, or the same manufacture as the building's main service disconnect equipment.
- E. Auto Start Destination Toggle Switch shall be provided to allow for the user to select which generator the ATS will start when the engine start signal is sent from the building automatic transfer switch.
- F. The Dual-Purpose Manual Transfer Switch integrated quick connects shall provide a connecting means for connecting a portable generator or a load bank.
- G. Generator quick connects:
 - 1. For 400A and below models, there shall be one (1) row of up to five (5) single pole connections.
 - 2. For 600A - 800A models, there shall be two (2) rows of up to five (5) single pole connections.
 - 3. For 1000A-1200A models, there shall be three (3) rows of up to 5 single pole connections.
 - 4. For 1600A models, there shall be four (4) rows of up to 5 single pole connections.
 - 5. For 2000A models, there shall be five (5) rows of up to 5 single pole connections.
 - 6. For 2500A models, there shall be seven (7) rows of up to 5 single pole connections.
 - 7. For 3000A models, there shall be eight (8) rows of up to 5 single pole connections.
- H. Neutral connections are not required for Load Bank connections:
 - 1. For 400A and below models, there shall be one (1) row of up to four (4) series single pole connections.
 - 2. For 600A - 800A models, there shall be two (2) rows of up to four (4) single pole connections.
 - 3. For 1000A-1200A models, there shall be three (3) rows of up to four (4) single pole connections.

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4. For 1600A models, there shall be three (3) rows of up to 4 single pole connections.
 5. For 2000A models, there shall be five (5) rows of up to 4 single pole connections.
 6. For 2500A models, there shall be seven (7) rows of up to 4 single pole connections.
 7. For 3000A models, there shall be eight (8) rows of up to 4 single pole connections.
- I. All electrical quick connectors shall be 16 Series cam type single pole connectors; color coded as per local industry standard practice:
1. 240V and below: phase 1 = black, phase 2 = red or orange for hi-leg, phase 3 = blue (if required).
 2. 480V: phase 1 = brown, phase 2 = purple or orange, phase 3 = yellow.
 3. Ground shall always be green.
 4. Neutral shall always be white.
 5. A minimum of 25% phase ampacity shall be provided for ground connections for portable generator and load bank connections.

2.5 ACCESSORIES

- A. Enclosure Heater(s): A 125-watt enclosure heater with transformer and thermostat (adjustable from 30° to 140 degrees F) shall be provided for outdoor installations where type 3R or 3RX, enclosures are specified. (This feature shall be equal to ASCO accessory 44G and shall be capable of being added to existing switches). Thermostat shall be set to 40-degrees F.
- B. Surge Suppression – A SPD with a surge current rating of 65kA shall be provided with individually matched fused metal oxide varistors (MOVs). It shall include LED status indication of normal operation, under voltage, power loss, phase loss or component failure. Shall include form C dry contacts for external alarm or monitoring. The unit shall be enclosed in a Noryl housing rated NEMA 4, 12, and 4X. Shall comply with UL 1449 latest edition. (This feature shall be equal to ASCO accessory 73).
- C. Shunt Trip Option on the Load Bank Breaker- 119LC - 24VDC Shunt Trip on the manual transfer switches load bank breaker to integrate with building automatic transfer switch. Load dump upon loss of utility source or automatic generator start signal from the automatic transfer switch. Circuit breakers 800 Amps and larger shall include GFI, Ground Fault Interrupter.
- D. Power Meter - ASCO 5210 Power Meter Connected to Load Side (135L)
- E. Accessory 171EP Base Package Bundle – Two form C contacts shall be connected to a terminal block that operate when Source 1 and Source 2 voltage is present at manual transfer switch terminals. The following indicators shall be provided:
1. Load Connected to Source 1 (Green).
 2. Load Connected to Source 2 (Red).
 3. Source 1 Available (Green).
 4. Source 2 Available (Red).
 5. Load Disconnect (Yellow)
 6. Phase Rotation Monitor
 7. Maintained Engine Start Switch and Common Alarm LED/Contact

2.6 WITHSTAND AND CLOSING RATINGS

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- A. The Manual Transfer Switch shall be rated to close on and withstand the available RMS symmetrical short circuit current at the terminals with the type of overcurrent protection shown on the plans.
1. Source 1 WCR ratings @ 480v shall be as follows when used with specific circuit breakers or current limiting fuses:

| MTDQ Size | Source 1 Withstand & Closing Rating MCCB | Source 1 W/CLF |
|---------------|--|----------------|
| 150A - 600A | 50,000A | 200,000A |
| 800A - 1200A | 50,000A | 200,000A |
| 1600A - 2000A | 65,000A | 200,000A |
| 2500A - 3000A | 100,000A | 200,000A |

2. Source 2 WCR ratings @ 600V shall be as follows when used with any molded case circuit breaker:

| MTDQ Size | Source 2 Withstand & Closing Rating MCCB at Source Wired to Quick Connects |
|---------------|--|
| 105A - 600A | 22,000A |
| 800A - 1200A | 22,000A |
| 1600A - 2000A | 65,000A |
| 2600A - 3000A | 100,000A |

2.7 TESTS AND CERTIFICATION

- A. The manual transfer switch shall be factory tested to ensure proper operation of the individual components and correct overall sequence of operation and to ensure compliance with the specification requirements.
- B. Upon request, the manufacturer shall provide a notarized letter certifying compliance with all of the requirements of this specification including compliance with the above codes and standards and withstand and closing ratings. The certification shall identify, by serial number(s), the equipment involved. No exceptions to the specifications, other than those stipulated at the time of the submittal, shall be included in the certification.
- C. The manual transfer switch manufacturer shall be certified to ISO 9001: 2008 International Quality Standard and the manufacturer shall have third party certification verifying quality assurance in design/development, production, installation and servicing in accordance with ISO 9001: 2008.

2.8 SERVICE REPRESENTATION

- A. The manual transfer switch 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.
- B. The manufacturer shall maintain records of switch shipments, by serial number, for a minimum of 20 years.
- C. For ease of maintenance, the manual transfer switch nameplate shall include drawing numbers and serviceable part numbers.

PART 3 - EXECUTION

DUAL PURPOSE MANUAL TRANSFER SWITCHES WITH INTEGRATED
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3.1 INSTALLATION

- A. General: Install manual transfer switches where shown, in accordance with the equipment manufacturer's written instructions and recognized industry practices to ensure that the transfer switch complies with the specified requirements and serve the intended purposes. Provide and install complete operating instructions in a Plexiglas enclosure for each type of transfer switch inside the enclosure.
- B. Standard: Comply with NEMA standards, requirements of the NEC, and applicable portions of NECA Standard of Installation pertaining to installation of manual transfer switches.
- C. Concrete Pad: Install free-standing floor or pad mounted manual transfer switches on a reinforced concrete pad. The pad shall extend 6" beyond the manual transfer switch base, unless shown otherwise. Furnish the exact position of any block outs, mounting bolts, and the dimensions and location of the manual transfer switch pad in a timely manner so as to prevent delay of the concrete work. Refer to Section 26 05 00 for housekeeping pads and Division 3 for Concrete Work.
- D. Provide circuits, conductors, and raceways as required for manual transfer switch options and accessories as required or specified. Provide separate dedicated circuits from the emergency branch circuit panel board to the manual transfer switch when required for indicated options or accessories. Provide control circuits from building automatic transfer switch to load bank shunt trip circuit breaker for load bank dump upon loss of building utility power.
- E. Provide shunt trip control of load bank circuit breaker to dump the load bank load if the building automatic transfer switch loses utility power.

3.2 GROUNDING

- A. Ground the manual transfer switch to the building grounding system and provide a driven ground electrode at the manual transfer switch location or bond to the building grounding system ground rod(s) if in close proximity.

3.3 CONTROLS

- A. Provide manual transfer switch load dump control wiring and raceway from the automatic transfer switch to the load bank shunt trip circuit breaker to dump the load bank load upon generator start signal from the building automatic transfer switch(es).

3.4 TESTING

- A. Notify Owner's Commissioning Authority (CxA) prior to performing any tests so the CxA may witness tests at his/her discretion. Refer to Section 26 01 00 Commissioning of Electrical Systems. Testing shall be witnessed by owner and Engineer.
- B. Coordinate testing of manual transfer switch with the testing of the permanent generator source and associated automatic transfer switches, including the generator load bank test.
- C. Contractor shall furnish all instruments, load banks, and personnel required for test. Submit 4 copies of certified test results to Architect/Engineer for review. Test reports shall include date and time of test, relative humidity, temperature, and weather conditions.

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- D. Pre-energization checks: Before energizing, check for continuous of circuits and for short circuits.
- E. Ground Fault Interrupter (GFI) test for load bank circuit breakers 1,000 Amps and larger: After completion of construction and before final acceptance testing, the ground fault protection system shall be field-tested and reset to the manufacturer's settings for both current and time by a representative of the manufacturer's engineering service department. After the test, set ground fault to 20 percent of overcurrent device rating or 600 Amperes, whichever is lower.
- E. Provide thermal infrared scan of the manual transfer switch under full load as directed and witnessed by Owner. Correct any deficiencies causing abnormal heating and repeat the scan. Provide digital video documentation with deficiencies corrected for comparison to future test. Make corrections as needed as soon as possible as directed by the Owner. Repeat the scan at the 11-month prior to close out and make corrections prior to close-out.
- F. Submittals: Furnish instruments and personnel required for tests. Submit 4 copies of certified test results to the Architect for review. Test reports shall include switchboard tested, date and time of test, relative humidity, temperature, and weather conditions.

3.5 TRAINING

- A. Provide four hours training, one hour each for four persons, four separate days. Coordinate with the Owner for manual transfer switch training which may coincide with any other related or required generator or automatic transfer switch training.

END OF SECTION

SECTION 26 43 00 - SURGE PROTECTION DEVICES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The Surge Protection Device (SPD) covered under this section includes service entrance type surge protection devices suitable for use as Type 1 or Type 2 Devices per UL1449 5th Edition, applied to the line or load side of the utility feed inside the facility. SPDs shall be connected in parallel with the facility's wiring system. The unit shall be manufactured in the USA by a qualified manufacturer of suppression filter system equipment, which has been engaged in the commercial design and manufacture of such products for a minimum of five years.
- B. Contractor shall provide all labor, materials, equipment, and incidentals as shown, specified and required to finish and install surge protection devices.

1.2 QUALITY ASSURANCE

- A. Reference Standard: Comply with the latest edition of the applicable provisions and recommendations of the following, except as otherwise stated in this document:
 - 1. UL 1449 Fifth Edition
 - 2. ANSI/IEEE C62.41, Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.
 - 3. ANSI/IEEE C62.45, Guide for Surge Testing for equipment connected to Low-Voltage AC Power Circuits.
 - 4. IEEE 1100 Emerald Book.
 - 5. National Fire Protection Association (NFPA 70 (NEC), 75, and 78).
 - 6. UL 1283 – Electromagnetic Interference Filters
- B. When requested for verification, provide copies of the following:
 - 1. Copies of actual let through voltage data in the form of oscilloscope results for both ANSI/IEEE C62.41 Category C3 (combination wave) and B3 (Ring wave) tested in accordance with ANSI/IEEE C6245.
 - 2. Copies of test reports from a recognized independent testing laboratory, capable of producing 200kA surge current waveforms, verifying the suppressor components can survive published surge current rating on both a per mode and per phase basis using the ANSI/IEEE C62.41 impulse waveform C3 (8 x 20 microsecond, 20kV/10kA). Test data on an individual module is not acceptable.

1.3 SUBMITTALS

- A. Submit shop drawings complete with all technical information for specific unit dimensions, let through voltage data, detailed installation instructions, maintenance manual, and wiring configuration.
- B. Provide detailed marked-up copy of this specification with line-by-line compliance or exception statements to all provisions of this specification.
- C. Copies of Manufacturer's catalog data, technical information and specifications on equipment.
- D. Copies of documentation stating that the Surge Protection Device is listed from a Nationally Recognized Testing Laboratory (NRTL) (UL, ETL, etc.) and are tested and multi-listed to UL 1449 5th Edition and UL 1283.

- F. Copy of warranty statement clearly establishing the terms and conditions to the building/facility owner/operator.

1.4 WARRANTY

- A. The manufacturer shall provide a minimum 20-year warranty for high and very high exposure SPDs. Very high exposure unit warranties shall include exposure to temporary extended over-voltage conditions. Provide a minimum 15-year warranty for all medium exposure SPDs, and a minimum 10-year warranty for all other SPDs for parts from date of substantial completion against failure. Contractor shall assist the Owner with manufacturer warranty registration.

PART 2 – PRODUCTS

2.1 APPROVED MANUFACTURER

- A. Low exposure, minimum 10-year parts warranty, minimum 50k Amps per mode, 100k Amps per phase, Type 1 and Type 2.
 - 1. Recessed mount panelboard extension with brushed stainless-steel front:
 - a. ACT Communications:471- ###V-050-SS-F-PB flush series.
 - b. ABB Current Technology PX3-050-VVV- #X-SF-X-F- # series.
 - c. SSI Surge Suppression, Inc. CSMx12-FMPxSS series.
 - d. SST Southern Tier Technologies T45-VVVV-50-AWAJ2-C-RKSS(Stainless Steel front).
 - 2. Branch panelboard surface mounted:
 - a. ACT Communications 455 series.
 - b. ABB Current Technology CG3 60 series.
 - c. SSI Surge Suppression, Inc. CSMx12 series.
 - d. SST Southern Tier Technologies T45-VVVV-50AWAJ2-C
- B. Medium exposure, minimum 15-year parts warranty, minimum 120k Amps per mode, 240k Amps per phase, Type 2.
 - 1. ACT Communications 471 series.
 - 2. ABB Current Technology CGP3 125 series.
 - 3. SSI Surge Suppression, Inc. CSMx24 series.
 - 4. SST Southern Tier Technologies T45-VVVV-120A series
- C. High exposure, minimum 20-year parts warranty, minimum 200k Amps per mode, 400k Amps per phase, Type 2 SPD.
 - 1. ACT Communications 471 x200 series.
 - 2. ABB Current Technology TG3 200 series.
 - 3. SSI Surge Suppression, Inc. CHLxM series.
 - 4. SST Southern Tier Technologies T45-VVVV-200A series
- D. Very high exposure at service entrance 1,201 Amps and above: Minimum 20-year parts warranty; minimum 200k Amps per mode; 400k Amps per phase, Type 1 and 2 SPD:
 - 1. ACT Communications 471 x200 SEL series.
 - 2. ABB Current Technology SEL3 200 series.

The service entrance protector shall incorporate a combination of TPMOV and Selenium technology allowing for transient surge and temporary over voltage protection. The unit shall be able to prevent common temporary over voltages and high impedance faults from damaging the MOVs, increasing their longevity and ability to protect the critical load. Limited and Intermediate current TOVs can be caused by a loss of the neutral conductor in a split phase or three phase power system. The available fault current will be

determined by the impedance of the loads connected to the phases opposite the SPD and are typically in the range of 30A to 1000A. Minimum 20-year parts warranty, extended over-voltage protection, minimum 200k Amps per mode, 400k Amps per phase, Type 2 SPD. The Selenium elements must limit voltage to the MOV as a percent of nominal as outlined below:

| Overvoltage seen by MOVs as % of Nominal | | | | |
|--|-------------------|------|------|-------|
| | available current | | | |
| time | 30A | 100A | 500A | 1000A |
| 1 cycle | 120% | 130% | 150% | 160% |
| 10 cycles | 130% | 150% | 160% | 160% |
| 30 cycles | 140% | 150% | 160% | 160% |

*To verify damage to the MOVs has been mitigated, the percent overvoltage seen at the MOV must be less than 200% for split-phase applications or 173% for three-phase applications (100% is nominal).

2.2 MANUFACTURED UNITS / ELECTRICAL REQUIREMENTS

- A. Declared Maximum Continuous Operating Voltage (MCOV) shall be greater than 115 percent of the nominal system operating voltage and in compliance with test and evaluation procedures outlined in the nominal discharge surge current test of UL1449, section 37.7.3. MCOV values claimed based on the component's value or on the 30-minute 115% overvoltage test in UL1449 will not be accepted.
- B. Unit shall have not more than 10% deterioration or degradation of the UL1449, Voltage Protection Rating (VPR) due to repeated surges.
- C. Protection Modes SVR (6kV, 500A) and UL1449 VPR (6kV, 3kA) for grounded WYE/delta and High Leg Delta circuits with voltages of (480Y/277), (208Y/120), (600Y/347). 3-Phase, 4 wire circuits, (120/240) split phase shall be as follows and comply with test procedures outlined in UL1449: Values Depicted are based on a system Without Disconnect / With Disconnect

| System Voltage | Mode | MCOV | C3 Wave | UL 1449 VPR Rating |
|----------------|------|------|-----------|--------------------|
| 120/240 | L-N | 150 | 650/775 | 700/800 |
| 120/208 | L-G | 150 | 650/825 | 700/900 |
| | N-G | 0 | 500/500 | 900/1000 |
| | L-L | 300 | 950/1250 | 900/1200 |
| 277/480 | L-N | 320 | 1125/1225 | 900/1200 |
| | L-G | 320 | 1075/1225 | 1200/1200 |
| | N-G | 0 | 900/900 | 1200/1500 |
| | L-L | 550 | 1950/2200 | 1800/1800 |

- D. Electrical Noise Filter- each unit shall include a high-performance EMI/RFI noise rejection filter. Noise attenuation for electric noise shall be as follows using the MIL-STD-220A insertion loss test method.
 1. 14 dB from 10 kHz to 1 MHz.
- E. Each Unit shall provide the following features:
 1. Phase Indicator lights, Form C dry contacts, counter and audible alarm.
 2. Field testable while installed.
 3. High performance interconnecting cable.
 4. The UL 1449 Voltage Protection Rating (VPR) shall be permanently affixed to the SPD unit.
 5. The UL 1449 Nominal Discharge Surge Current Rating shall be 20kA
 6. The SCCR rating of the SPD shall be 200kAIC without requiring an upstream protection device for safe operation.

7. The unit shall be listed as a Type 2 SPD per UL1449.
8. Power wiring: SPD shall be equipped with mechanical lugs that can accept up to #2 AWG wire on High Exposure units and up to #6 on Medium and Low Exposure units.

2.3 POWER CABLES FOR CONNECTION

- A. Power wiring: Conductors between all high and very-high SPDs and switchgear shall be high performance interconnect system "Low Z Cable" cables with Ultra Low impedance characteristics at 10kHz and above.
- B. High Performance Low Impedance cable shall be #6 AWG minimum for Very High, High, and Medium Exposure SPDs and #10 AWG minimum for Low Exposure SPDs.

PART 3 – EXECUTION

3.1 GENERAL INSTALLATION

- A. The unit shall be installed as close as practical to the facility's wiring system in accordance with applicable national/local electrical codes and the manufacturer's recommended installation instructions. Connection shall be with high performance, low impedance cables in conduit and shall not be any longer than necessary, avoiding unnecessary bends. Minimum wire size and overcurrent protection device for disconnect shall be provided and as recommended by the manufacturer.
- B. Units specified for lighting and appliance panel boards as panelboard extensions (EGPE) shall be mounted directly above or below the first section of the panel board it is protecting. Any other mounting location will not be acceptable and shall be corrected, without exception, at no additional cost to the Owner.
- C. Units specified for panelboards, switchboards, or motor control centers shall be mounted directly above or adjacent to the panelboard, switchboard or motor control center using unistrut supports secured to structure as required. Conduit length between power distribution panelboard or switchboard shall be less than two inches. Mounting above equipment is not acceptable.
- D. Overcurrent device and conductors for devices shall be the maximum recommended by the manufacturer. Manufacturer's recommendations shall prevail over the information given in the plans and specifications.
- E. Provide recessed mounted panelboard extension type enclosures for devices protecting recessed panelboards. Enclosure front shall match panelboard front material and finish. Provide brushed stainless-steel front at kitchens and food processing areas.

3.2 UNIT SELECTION BASED ON EXPOSURE LEVEL

- A. (SPDVH) Provide very-high exposure SPDs with Selenium and TPMOV technology for the following new electrical equipment or where indicated:
 1. Service entrance rated 1,201 Amps and above.
- B. (SPDH) Provide high exposure SPDs for the following new electrical equipment or where indicated:
 1. Service entrance rated 801 – 1,200 Amps.
 2. Switchboards located outside.

- C. (SPDM): Provide medium exposure SPDs at the following new electrical equipment or where indicated:
 - 1. Service entrance rated 401 - 800 Amps.
 - 2. Panelboards above 600 Amps.
 - 3. Motor control centers.
 - 4. Non-service entrance switchboards.

- D. (SPDL): Provide low exposure SPDs at the following new electrical equipment or where indicated:
 - 1. Service entrance rated 400 Amps and below.
 - 2. Panelboards 600 Amps and below.

3.3 TESTING

- A. Factory Trained Representative shall provide start-up to include initial verification of proper installation, shortest cable connection, and initiate factory warranty. The technician will be required to do the following as a minimum:
 - 1. Verify the installation follows applicable national / local electrical codes related to SPDs and the manufacturer's Installation, Operation and Maintenance Instructions and recommendations.
 - 2. Verify overcurrent device rating.
 - 3. Verify all wiring connections and installation conforms to manufacturer's recommendations.
 - 4. Record information for each product installed and include in O&M Manual

- B. A copy of the Factory diagnostic test report and written approval of the installation shall be included with the Electrical Operating and Maintenance Manual. The Contractor shall make all adjustments, changes, corrections, etc. as required by the Factory Trained Representative so that the installation follows the manufacturer's installation and operation instructions without additional charge to the Owner.

END OF SECTION

SECTION 26 51 13 - LIGHTING FIXTURES

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Work Included: Lighting fixture work is as shown, scheduled and specified.
- B. Applications: The applications of lighting fixtures required for the project include the following:
 - 1. General lighting
 - 2. Emergency lighting
 - 3. Outdoor area lighting

1.2 QUALITY ASSURANCE

- A. Provide interior building LED fixtures that comply with the Design Lights Consortium (DLC) standards and are DLC or DLC Premium listed as a Qualifying Product at time of proposal submittal date.
- B. UL Standards: Lighting fixtures shall conform to applicable UL standards, and be UL or ETL labeled.
- C. Light fixtures shall conform to the requirements of NFPA 101, and 70 (NEC).

1.3 SUBMITTALS

- A. Submit product data for light fixtures, and emergency lighting equipment, including generator transfer devices.
- B. Specification Compliance Review: Mark up a complete copy of the specification section for the product to indicate a) acknowledgement of the specification requirement (Comply), or b) acknowledgement that the particular specification requirement does not apply to this specific project (Not Applicable) or, c) acknowledgement that the specification requirement cannot be made or that a variance is being submitted for review to the Architect / Engineer / Owner (Does Not Comply, Explanation:) Do not submit an outline form of compliance, submit a complete copy with the product data.
- C. Submittal data shall include luminaire efficiency parameters.
- D. Submittal data for exterior luminaires shall include IESNA BUG ratings, backlight, uplight, and glare ratings of each unique luminaire for the orientation and tile specified. Indicate total absolute lumens per luminaire and absolute lumens emitted above horizontal based by each luminaire for the orientation and tile specified.

1.4 WARRANTY

- A. Provide 5-year warranty on all light fixtures, including internal or remote LED drivers, all other electrical internal electrical or electronic components except for emergency battery packs or emergency load control device relays. Refer to other specific component warranty requirements below.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturers: Provide products produced by manufacturers shown or scheduled for each type of lighting fixture. Refer to drawings for additional approved manufacturers.
1. Light fixtures:
 - US LED
 - Extra Light
 - Acuity
 - Hubbell
 - Signify
 - Cooper Lighting Solutions
 - Pinnacle
 - HE Williams
 - GE Current
 - LSI
 2. LED Drivers:
 - Philips
 - Osram Optotronic
 - Eldo LED
 3. Emergency Battery Packs with self-testing drivers/inverters:
 - Bodine
 - Chloride
 - Lithonia
 - Dual Lite
 - IOTA
 4. Emergency Generator/Inverter Load Control Bypass Relay (ELC); UL924 listed and 0-10Vdc compatible:
 - Bodine
 5. Emergency Generator / Inverter Branch Circuit Transfer Switch, UL 1008 listed and 0-10Vdc compatible:
 - Bodine GTD20A

2.2 MATERIALS AND COMPONENTS

- A. General: Provide lighting fixtures of the size, type, and rating indicated, with all accessories for a complete aesthetic installation.
- B. Fixture Types:
1. General:
 - a. LED Lay-in edge lit or back flat panel / troffer fixtures: Opaque, edge or back lighted, 4000 Kelvin color temperature. 0-10 Vdc dimmable, L70: 60,000 minimum hours.
 - b. Safety chains and wire guards at fixtures in mechanical and electrical rooms, and high abuse areas. Provide safety chains only for gymnasium fixtures which shall be inherently vandal proof, no wire guards.
 - c. Fixtures located outdoors, in interior unconditioned spaces, and in wet locations shall be of aluminum construction.
 - d. Fixtures with door frames shall be of aluminum construction, white finish where located in kitchens, food prep areas, toilets, restrooms, locker rooms, dressing rooms, showers, and unconditioned spaces.
 - e. DLC, DLC Premium or Energy Star qualified unless specified otherwise.
 - f. Outdoor fixtures shall include a discrete / replaceable surge suppression device in addition to the surge suppression incorporated in the LED driver.
 - g. Operating temperature rating shall be between -40 degrees F and 120 degrees F.

- i. Color Rendering Index (CRI): ≥ 80 Indoor; ≥ 65 Outdoor
 - j. The manufacturer shall have performed JEDEC (Joint Electron Devices Engineering Council) reliability tests on the LEDs as follows: High Temperature Operating Life (HTOL), Room Temperature Operating Life (RTOL), Low Temperature Operating Life (LTOL), Powered Temperature Cycle (PTMCL), Non-Operating Thermal Shock (TMSK), Mechanical Shock Variable Vibration Frequency, and Solder Heat Resistance (SHR).
 2. Downlight Fixtures: Provide recessed downlight fixtures with trim rings compatible with the ceiling material where fixture is to be installed.
 3. LED Exit Signs: Provide red lettering. The exit lighting fixtures shall meet the requirements of Federal, State, and Local Codes.
 - a. Gymnasiums, locker rooms, athletic/PE wing and associated corridors, black box theaters, auditorium stages, cafeteriums and kitchens: Vandal resistant, wet location cast aluminum with polycarbonate protective cover exit signs, Lithonia Extreme Series.
 4. Emergency Lighting Units: Lead Calcium batteries with self-diagnostics. Provide full light output at 90 minutes of battery operation. LED lamps.
 5. Gymnasium light fixtures, glass or acrylic refractors or lenses, round profile, single point swivel pendant or hook mounting, designed to be vandal proof without the need for wire guards, no wire guards.
- C. LED drivers:
1. NEMA 410 compliant for in-rush current.
 2. Starting Temperature: -40° F [-40° C].
 3. Input Voltage: 120 to 480 ($\pm 10\%$) V.
 4. Power Supplies: Class I or II output.
 5. Surge Protection: The system must survive 250 repetitive strikes of "C Low" (C Low: $6\text{kV}/1.2 \times 50 \mu\text{s}$, $10\text{kA}/8 \times 20 \mu\text{s}$) waveforms at 1-minute intervals with less than 10% degradation in clamping voltage. "C Low" waveforms are as defined in IEEE/ASNI C62.41.2-2002, Scenario 1 Location Category C.
 6. Power Factor (PF): ≥ 0.90 .
 7. Total Harmonic Distortion (THD): $\leq 20\%$.
 8. Comply with FCC Title 47 CFR Part 18 Non-consumer RFI/EMI Standards.
 9. Drivers shall be reduction of hazardous substances (ROHS)-compliant.
- D. Voltage: Equipment for use on 120V systems shall be suitable and guaranteed for voltage range of 100V to 130V. Equipment on 277V systems shall be suitable and guaranteed for voltage range of 225V to 290V. Universal voltage equipment shall be suitable and guaranteed for a voltage range of 100V to 290V.
- E. Light fixture housing for exterior use: Provide aluminum or stainless housing. Where stainless steel hardware is used, both male and female fasteners shall be stainless steel.
- F. Emergency LED battery self-testing drivers and inverters; 5-year warranty. Basis of Design:
1. Bodine BSL-ST Series for OEM installation
 2. Bodine BSL310-SI Series for field installation
 3. Bodine ELI-S Series for line voltage sine wave inverter field installation
- G. Emergency Battery Packs – Exit Signs: Nickel Cadmium battery with self- diagnostics; Minimum 3-year non-prorated replacement warranty.
- H. Emergency Generator / Inverter Load Control Device (ELC):
1. 16 Amp minimum ballast / driver load
 2. Compatible with 0-10 Volt dimmer switches
 3. UL 924

4. Minimum 3-year warranty
 5. Integral or remove test switch.
- I. Emergency Generator / Inverter branch circuit transfer switch:
 1. UL 1008
 2. 20 Amp ballast/driver load
 3. 0-10Vdc dimming compatible

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install lighting fixtures of the types indicated, where shown, and at indicated heights in accordance with the fixture manufacturer's written instructions and industry practices to ensure that the fixtures meet the specifications. Fixtures shall fit the type of ceiling system scheduled.
- B. Standards: Comply with NEMA standards, applicable requirements of NEC pertaining to installation of interior lighting fixtures, and with NECA Standard of Installation.
- C. Attachment: Fasten fixtures to the indicated structural support members of the building. Provide four separate wire supports for recessed ceiling mounted lighting fixtures, one at each corner of fixture. Check to ensure that solid pendant fixtures are plumb. Provide T-bar locking clips on all four sides for lay-in fixtures.
- D. Coordination: Field coordinate and locate lighting fixtures in open ceiling areas including mechanical and electrical rooms so that light is not obstructed by piping, ductwork, etc. Locate light fixtures in front of electrical and mechanical equipment to provide adequate illumination for testing and maintenance. Relocate installed light fixtures as directed by Owner / Architect at no additional cost.
- E. Final adjustment of all aimable exterior light fixtures shall be in coordination with, and to the satisfaction of, the Owner's designated representative. Pre-aim all fixtures prior to scheduled final aiming and adjustment with Architect / Owner. Verify that all rotatable optics are in their proper orientation prior to final aiming.
- F. Provide vandal resistant exit signs without wire guards in all physical education and athletic sports areas, including egress corridors adjacent to these areas, black box theaters, auditorium stages, vocational shops, cafeteriums and kitchens.
- G. Provide exit sign directional arrows as required. Provide a minimum of two and a maximum of 10% spare exit signs to be installed as directed by Architect.
- H. Install in accordance with manufacturers instructions.
- I. Install suspended luminaires using pendants supported from swivel hangers. Provide pendant length required to suspend luminary at indicated height.
- J. Locate recessed ceiling luminaires as indicated on the Architectural reflected ceiling plan.
- K. Install surface mounted luminaires plumb and adjust to align with building lines and with each other. Secure to prohibit movement.
- L. Exposed Grid Ceilings: Support surface mounted luminaires on grid ceiling directly from building structure. Provide auxiliary members spanning ceiling Ts to support surface

- mounted luminaires. Fasten surface mounted luminaires to ceiling T using bolts, screws, rivets, or suitable clips.
- M. Install recessed luminaires to permit removal from below.
 - N. Install recessed luminaires using accessories and fire stopping materials to meet regulatory requirements for fire rating.
 - O. Install wall-mounted luminaires at height as directed by Architect.
 - P. Install accessories furnished with each luminary.
 - Q. Connect luminaires to branch circuit outlets using flexible conduit as specified.
 - R. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaires.
 - S. Bond products and metal accessories to branch circuit equipment grounding conductor.
 - T. Provide emergency transfer devices for light fixtures powered by generator or inverter emergency lighting circuits which are used for normal lighting and to be switched with the switched normal lighting circuit in the same room, corridor or area.
 - U. Provide un-switched, constant-hot circuit to all battery powered emergency lighting equipment and emergency load control devices (ELC). Where normal light fixture circuit is switched or contactor controlled, non-switched battery charging or ELC circuit shall originate from same branch circuit breaker as switched lighting circuit.
 - V. Provide emergency powered light fixture in front of all electrical switchgear, including but not limited to panelboards, switchboards, motor control centers, low voltage control panels, transfer switches, motor controllers and disconnect switches.
 - W. Provide emergency battery operated light fixtures at all transfer switch locations and at all central battery emergency lighting inverters.
 - X. Provide automatic controls for exterior light fixtures. Exterior building mounted light fixtures shall be circuited through lighting contactors. Lighting contactors shall be controlled by the Building Management System. Provide separate lighting contactors for:
 - 1. Parking Lot Lighting
 - 2. Building Mounted Lighting
 - 3. Exterior Signage
 - Y. Lighting contactors shall not be installed above ceiling and shall be readily accessible, located in same room as panelboard serving load.
 - Z. Wall mounted light fixtures shall be attached to the studs in the walls. Attachment to gypsum board only is not acceptable. Where wall mounted fixtures attach to junction box only, firmly secure junction box to adjoining studs in wall.
 - AA. Lighting Fixture Supports:
 - 1. Shall provide support for all of the fixtures. Supports may be anchored to channels of the ceiling construction to the structural slab or to structural members within a partition, or above a suspended ceiling.
 - 2. Shall maintain the fixture positions after cleaning and relamping.
 - 3. Shall support the lighting fixtures without causing the ceiling or partition to

deflect.

- BB. Hardware for surface mounting fixtures to suspended ceilings:
1. In addition to being secured to any required outlet box, fixtures shall be bolted to a grid ceiling system at four points spaced near the corners of each fixture. The bolts shall be not less than 1/4 inch secured to channel members attached to and spanning the tops of the ceiling structural grid members. Non-turning studs may be attached to the ceiling structural grid members or spanning channels by special clips designed for the purpose, provided they lock into place and require simple tools for removal.
 2. In addition to being secured to any required outlet box, fixtures shall be bolted to ceiling structural members at four points spaced near the corners of each fixture. Pre-positioned 1/4-inch studs or threaded plaster inserts secured to ceiling structural members shall be used to bolt the fixtures to the ceiling. In lieu of the above, 1/4-inch toggle bolts may be used on new or existing ceiling provided the plaster and lath can safely support the fixtures without sagging or cracking.
- CC. Lighting Fixture Supports for aluminum canopies:
1. Light fixtures mounted under aluminum canopies shall be UL wet location from above listed without a protective ceiling or cover. Light fixture shall not have conduit penetrations or mounting hole penetrations field made in the top of the fixture. Conduit penetration shall be at the end of the fixture only.

3.2 TESTING

- A. General: Upon installation of lighting fixtures, and after building circuits are energized, apply electrical energy to demonstrate proper operations of lighting fixtures, emergency lighting, and controls. When possible, correct malfunctioning units at the site, then retest to demonstrate proper operation; otherwise, remove and replace with new units, and proceed with retesting.
- B. Pre-Inspection Tasks: Immediately before final inspection, clean fixtures inside and out, including plastics and glassware, adjust trim to fit adjacent surfaces, replace broken or damaged parts, and lamp and test fixtures for electrical and mechanical operations. Any fixtures, or parts of fixtures that show signs of rust or corrosion at the time of completion, shall be removed, and replaced with protected metal parts.
- C. Final aiming and Adjustment: Aim and adjust aimable and adjustable lighting fixtures for their intended purpose. Re-aim and re-adjust as required to the satisfaction of the Architect / Owner, including nighttime adjustment of exterior lighting in the presence of the Architect / Owner.

END OF SECTION

SECTION 265561 - THEATRICAL LIGHTING AND RIGGING SYSTEMS REFERENCE

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Theatrical Lighting System.
- B. Theatrical Rigging System.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Construction Contract, including General Conditions and Division 1 Specification Sections, apply to this Section.
- B. Theatrical lighting system TL series drawings and 11 61 00 specification.
- C. Theatrical rigging system TE series drawings and 11 61 33 specification.

1.3 RESPONSIBILITY AND RELATED WORK

- A. Coordinate scheduling of work with the Owner and Owner's Architect.
- B. Refer to TL0.00 and TE0.00 for division of responsibilities related to the theatrical lighting and rigging systems.

1.4 DEFINITION OF TERMS & ABBREVIATIONS:

- A. Provide: to supply and install.
- B. Furnish: to supply to another contractor for installation.
- C. Supply: to supply but not install.
- D. Install: to install but not supply.
- E. OFE: Owner furnished (supplied) equipment. Equipment will be provided to contractor for installation.
- F. NIC: Not In Contract. Refers to items that are not included in the scope of work outlined in this section but may be shown for coordination purposes or reference.
- G. Future: Equipment that will be provided by owner later. Accommodations shall be provided for future equipment as shown on the drawings.

PART 2 - PRODUCTS

2.1 NOT APPLICABLE

END OF SECTION

SECTION 26 56 67 - SPORTS FIELD LIGHTING SYSTEM

PART 1 – GENERAL

1.1 SUMMARY

- A. Work covered by this section of the specifications shall conform to the contract documents, engineering plans as well as state and local codes.
- B. The purpose of these specifications is to define the lighting system performance and design standards for athletic fields using an LED Lighting source. The manufacturer / contractor shall supply lighting equipment to meet or exceed the standards set forth in these specifications. Basis of design manufacture: Musco.
- C. The sports lighting will be for the following venues:
 - 1. Tennis
- D. The primary goals of this sports lighting project are:
 - 1. Guaranteed Light Levels: Selection of appropriate light levels impact the safety of the players and the enjoyment of spectators. Therefore, light levels shall be guaranteed to not drop below specified target values for a period of 25 years from date of delivery of equipment to the site.
 - 2. Environmental Light Control: It is the primary goal of this project to minimize spill light to adjoining properties and glare to the players, spectators, and neighbors.
 - 3. Life-cycle Cost: In order to reduce the operating budget, the preferred lighting system shall be energy efficient and cost effective to operate. All maintenance costs shall be the responsibility of the manufacturer as indicated and included at no additional cost to the Owner for the duration of the warranty.
 - 4. Control and Monitoring: Provide a remote on/off control system for the lighting system. Fields shall be proactively monitored to detect luminaire outages over the 25-year life cycle. All communication and monitoring costs for 25-year period shall be included at no additional cost to the Owner.
- E. All lighting designs shall comply with local lighting ordinances.

1.2 SPECIFICATION COMPLIANCE REVIEW

- A. Provide a complete written, item-by-item specification review indicating compliance or deviation in full description.
- B. Mark up a complete copy of the specification section for the product to indicate a) acknowledgement of the specification requirement (Comply), or b) acknowledgement that the particular specification requirement does not apply to this specific project (Not Applicable) or, c) acknowledgement that the specification requirement cannot be made or that a variance is being submitted for review to the Architect / Engineer / Owner (Does Not Comply, Explanation:) Do not submit an outline form of compliance, submit a complete copy of the specification with the product data.

1.3 WARRANTY AND GUARANTEE

- A. 25-Year Warranty: Manufacturer shall provide a signed warranty covering the entire system for 25 years from the date of delivery to the site. The warranty shall guarantee specified light levels. The manufacturer shall maintain specifically funded financial

reserves to assure fulfillment of the warranty for the full term. Warranty does not cover acts of God, weather conditions events such as lightning or hail damage, improper installation, vandalism or abuse, unauthorized repairs or alterations, or products made by other manufacturers.

- B. Maintenance: Manufacturer shall monitor the performance of the lighting system, including on/off status, hours of usage and luminaire outage for 25 years from the date of equipment shipment. Parts and labor shall be covered such that individual luminaire outages will be repaired when the usage of any field is materially impacted. Manufacturer shall provide all preventative and spot maintenance, including parts and labor for 25 years from the date of equipment shipment. Individual outages shall be repaired when the usage of any field is materially impacted. In event of an outage, Owner shall verify for the manufacturer that power is available to each lighting circuit controller, fuses , and lighting contactors.

PART 2 – PRODUCTS

2.1 ILLUMINATION PERFORMANCE REQUIREMENTS

- A. Illumination Levels and Design Factors: Playing surfaces shall be lit to an average target illumination level and uniformity as specified in the chart below. Lighting calculations shall be developed, and field measurements taken on the grid spacing with the minimum number of grid points specified below. Appropriate light loss factors including but not limited to dirt depreciation and optical material deterioration shall be applied and submitted for the basis of design. Average illumination level shall be measured in accordance with the IESNA LM-5-04 (IESNA Guide for Photometric Measurements of Area and Sports Lighting Installations). Illumination levels shall not drop below desired target values in accordance to IES RP-6-15, Page 2, Maintained Average Illuminance and shall be guaranteed for the full warranty period. Due to various dimensions of some athletic fields the actual quantity of grid points may vary, however the grid spacings shall be taken over the entire playing surface and the exact quantity adjusted accordingly.

| Area of Lighting: Average annual usage | Average Target Illumination Levels | Maximum to Minimum Uniformity Ratio | Minimum Grid Points | Grid Spacing |
|---|------------------------------------|-------------------------------------|---------------------|--------------|
| Tennis | 50 foot-candles | 1.5:1.0 | 60/court | 20' x 20' |

- B. Color: The lighting system shall have a-color temperature of 4000K-5700K and a minimum CRI of 75.
- C. Mounting Heights: To ensure proper aiming angles for reduced glare and to provide better playability, minimum mounting heights shall be as described below. Provide mounting heights as required based on pole locations and setback from the field of play. Higher mounting heights may be required based on photometric report and ability to ensure the top of the field angle is a minimum of 10 degrees below horizontal.
- D. Aiming of any luminaire shall not be greater than 60 degrees from nadir.
- E. Center of luminaire cluster height at top of light poles: Typical average mounting height of a light cluster $H = [(1/3 W) + SB] \times \tan 30$. Width (W)] = width of playing surface from foul line or inbound/outbound line to the opposite foul line or

inbound/outbound line in the direction of the principal aiming of respective light standard pole. Pole Set Back (SB) = the distance from the nearest foul line or inbound/outbound line to the proposed light standard pole location.

- F. Unless indicated otherwise the center of an individual luminaire cluster's mounting height shall be as recommended by IES due to pole set back but in no case, shall any aiming angle of any luminaire aimed to the sports field exceed 60 degrees from nadir.

2.2 ENVIRONMENTAL LIGHT CONTROL

- A. Light Control Luminaires: All luminaires shall utilize spill light and glare control devices including, but not limited to, optical lensing, internal shields, louvers, or external shields.
- B. The first page of a photometric report for all luminaire types proposed showing horizontal and vertical axial candle power shall be provided to demonstrate the capability of achieving the specified performance. Reports shall be certified by a qualified independent testing laboratory with a minimum of five years' experience or by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products. A summary of the horizontal and vertical aiming angles for each luminaire shall be included with the photometric report.

2.3 SPORTS LIGHTING SYSTEM CONSTRUCTION

- A. Manufacturing Requirements: All components shall be designed and manufactured as a system. All luminaires, wire harnesses, drivers and other enclosures shall be factory assembled, aimed, wired and tested prior to shipment.
- B. Durability: All exposed components shall be constructed of corrosion resistant material and/or coated to help prevent corrosion. All exposed carbon steel shall be hot dip galvanized per ASTM A123. All exposed aluminum shall be powder coated with high performance polyester or anodized. All exterior reflective inserts shall be anodized, coated, and protected from direct environmental exposure to prevent reflective degradation or corrosion. All exposed hardware and fasteners shall be stainless steel of 18-8 grade or better, passivated and coated with aluminum-based thermosetting epoxy resin for protection against corrosion and stress corrosion cracking. Structural fasteners may be carbon steel and galvanized meeting ASTM A153 and ISO/EN 1461 (for hot dipped galvanizing), or ASTM B695 (for mechanical galvanizing). All wiring shall be enclosed within the cross-arms, pole, or electrical components enclosure.
- C. System Description: Lighting system shall consist of the following:
 - 1. Galvanized steel poles with maintenance platform/cage, climbing pegs, and cross-arm assembly.
 - 2. Non-approved pole technology:
 - a. Square static cast concrete poles will not be accepted.
 - b. Direct bury steel poles which utilize the extended portion of the steel shaft for their foundation will not be accepted due to potential for internal and external corrosive reaction to the soils and long-term performance concerns.
 - 3. Lighting systems shall use concrete foundations.
 - a. For a foundation using a pre-stressed concrete base embedded in concrete backfill, the concrete shall be air-entrained and have a minimum compressive design strength at 28 days of 3,000 PSI. 3,000

- PSI concrete specified for early pole erection, actual required minimum allowable concrete strength is 1,000 PSI. All piers and concrete backfill must bear on and against firm undisturbed soil.
- b. For anchor bolt foundations or foundations using a pre-stressed concrete base in a suspended pier or reinforced pier design pole, erection may occur after 7 days, or after a concrete sample from the same batch achieves a specified strength approved by the structural engineer.
4. Manufacturer shall supply all LED drivers and supporting electrical equipment
 - a. Remote drivers and supporting electrical equipment shall be mounted approximately 10 feet above grade in aluminum NEMA 3RX enclosures. The enclosures shall be touch-safe and include drivers and fusing with indicator lights on fuses to notify when a fuse is to be replaced for each luminaire. Disconnect per circuit for each pole structure shall be located in the enclosure.
 5. Manufacturer shall provide surge protection at the pole equal to or greater than 40 kA for each line to ground (Common Mode) as recommended by IEEE C62.41.2_2002.
 6. Wire harness shall be complete with an abrasion protection sleeve, strain relief and plug-in connections for fast, trouble-free installation.
 7. All luminaires, visors, and cross-arm assemblies shall withstand 150 mph winds and maintain luminaire aiming alignment.
 8. Control cabinet shall provide remote on-off control and monitoring of the lighting system.
 9. Manufacturer shall provide lightning protection and grounding as defined by NFPA 780 and be UL Listed per UL 96 and UL 96A.
 - a. Integrated grounding via concrete encased electrode grounding system.
 - b. If grounding is not integrated into the structure, the manufacturer shall supply grounding electrodes, copper down conductors, and exothermic weld kits. Electrodes and conductors shall be sized as required by NFPA 780. The grounding electrode shall be minimum size of 5/8 inch diameter and 8 feet long, with a minimum of 10 feet embedment. Grounding electrode shall be connected to the structure by a grounding electrode conductor with a minimum size of 2 AWG for poles with 75 feet mounting height or less, and 2/0 AWG for poles with more than 75 feet mounting height.
- D. Safety: All system components shall be UL listed for the appropriate application.

2.4 ELECTRICAL

- A. Electric Power Requirements for the Sports Lighting Equipment:
 1. Maximum total voltage drop: Voltage drop to the disconnect switch located on the poles shall not exceed three (3) percent of the rated voltage.
- B. Equipment requiring electrical distribution more than that indicated or required by the basis of design shall be provided by the contractor at no additional cost to the Owner.

2.5 STRUCTURAL PARAMETERS

- A. Wind Loads: Wind loads shall be based on the latest published edition of the International Building Code and all local code requirements. Wind loads shall be

calculated using ASCE 7-10, an ultimate design wind speed of 120 mph and exposure category C.

- B. Manufacturer Pole Structural Design: The stress analysis and safety factor of the poles shall conform to the latest published edition of AASHTO Standard Specification for Structural Supports for Highway Signs, Luminaires, and Traffic Signals (LTS-5).
- C. Manufacturer Foundation Design: The foundation design shall be based on soil parameters as outlined in the geotechnical report. If a geotechnical report is not utilized, the foundation design shall be based on class 5 soils.
- D. Manufacturer Foundation Drawings: Project specific foundation drawings stamped by a registered engineer in the state where the project is located are required. The foundation drawings must list the moment, shear (horizontal) force, and axial (vertical) force at ground level for each pole.

2.6 CONTROL

- A. Instant On/Off Capabilities: System shall provide for instant on/off of luminaires. Contactors shall be rated 60A/3P to utilize existing 40 Amp feeder circuits.
- B. Lighting contactor cabinet(s) constructed of minimum NEMA Type 3RX aluminum, designed for easy installation with contactors, labeled to match field diagrams and electrical design. Manual off-on-auto (momentary ON/OFF reverting to the AUTO position) rotary (non-keyed) selector switches shall be provided. The system shall be programmed for manual ON/OFF operation only.
- C. Remote Lighting Control System: System shall allow Owner and users with a security code to schedule on/off system operation via a web site, phone, fax, or email up to ten years in advance. Manufacturer shall provide and maintain a two-way TCP/IP communication link. Trained staff shall be available 24/7 to provide scheduling support and assist with reporting needs.
 - 1. The owner may assign various security levels to schedulers by function and/or fields. This function must be flexible to allow a range of privileges such as full scheduling capabilities for all fields to only having permission to execute "early off" commands. The scheduling tool shall be capable of setting curfew limits.
 - 2. Controller shall accept and store 7-day schedules, be protected against memory loss during power outages, and shall reboot once power is regained and execute any commands that would have occurred during outage.
- D. Remote Monitoring System: System shall monitor lighting performance and notify manufacturer if individual luminaire outage is detected so that appropriate maintenance can be scheduled. The controller shall determine switch position (manual or auto) and contactor status (open or closed).
- E. Management Tools: Manufacturer shall provide a web-based database and dashboard tool of actual field usage and provide reports by facility and user group. Dashboard shall also show current status of luminaire outages, control operation, and service. Mobile applications shall be provided suitable for IOS, and Android devices.
- F. Hours of Usage: Manufacturer shall provide a means of tracking actual hours of usage for the field lighting system that is readily accessible to the owner.
 - 1. Cumulative hours: shall be tracked to show the total hours used by the facility
 - 2. Report hours saved by using early off and push buttons by users.

- G. Communication Costs: Manufacturer shall include communication costs for operating the controls and monitoring system for a period of 25 years.

2.7 CONTROL OF EXISTING NON-MUSCO LIGHT POLES

- A. Provide three additional controlled 60A/3P lighting contactors for control of existing HID tennis court lighting. Include spare cabinet space as needed for future equipment/controls for monitoring of these three additional contactor circuits for future HID replacement to Musco LED.

PART 3 – EXECUTION

3.1 SOIL QUALITY CONTROL

- A. It shall be the Contractor's responsibility to notify the Architect/Engineer/Owner immediately if unforeseen soil conditions exist other than those on which the foundation design is based or indicated in the project's Geotechnical Report, or if the soil cannot be readily excavated.
 - 1. Provide engineered foundation embedment design by a registered engineer in the State where the project is located for soils other than specified soil conditions.
 - 2. Provide additional materials required to achieve alternate foundation design.
 - 3. Excavate and remove from the site materials other than normal soils, such as rock, caliche, etc.

3.2 FIELD QUALITY CONTROL

- A. Illumination Measurements: Upon substantial completion of the project and in the presence of the Contractor, Project Engineer, Owner's Representative, and Manufacturer's Representative, illumination measurements shall be taken and verified. The illumination measurements shall be conducted in accordance with IESNA LM-5-04.
- B. Field Light Level Accountability
 - 1. Light levels shall be guaranteed not to fall below the target maintained light levels for the entire warranty period of 25 Years.
 - 2. The contractor/manufacturer shall be responsible for an additional inspection one year from the date of substantial completion or commissioning of the lighting system and shall also utilize the Owner's light meter in the presence of the Owner at the Owner's request.
 - 3. The contractor/manufacturer shall make all changes needed to bring the fields back to compliance for light levels and uniformities. Contractor/Manufacturer shall be held responsible for any damage to the fields during these repairs and make repairs to the satisfaction of the Owner at no additional cost.
- C. Correcting Non-Conformance: If, in the opinion of the Owner or his appointed Representative, the actual performance levels including foot-candles and uniformity ratios are not in conformance with the requirements of the performance specifications and submitted information, the Contractor/Manufacturer shall make all adjustments required to meet specifications and satisfy the Owner at no additional cost to the Owner.

END OF SECTION

SUBMITTAL INFORMATION
Design Submittal Data Checklist and Certification

All items listed below are mandatory, shall comply with the specification and be submitted according to pre-bid submittal requirements

| Include d | Tab | Item | Description |
|------------------|------------|-------------------------------|--|
| | A | Letter/ Checklist | Listing of all information being submitted must be included on the table of contents. List the name of the manufacturer's local representative and his/her phone number. Signed submittal checklist to be included. |
| | B | On Field Lighting Design | Lighting design drawing(s) showing: a. Field Name, date, file number, prepared by, and other pertinent data b. Outline of field(s) being lighted, as well as pole locations referenced to the center of the field (x & y), or home plate for baseball / softball fields. Illuminance levels at grid spacing specified c. Pole height, number of fixtures per pole, as well as luminaire information including wattage, lumens and optics d. Height of meter above field surface e. Summary table showing the number and spacing of grid points; average, minimum and maximum illuminance levels in foot candles (fc); uniformity including maximum to minimum ratio, coefficient of variance and uniformity gradient; number of luminaries, total kilowatts, average tilt factor; light loss factor. f. Alternate manufacturers shall provide both initial and maintained light scans using a maximum 0.70 Light Loss Factor to calculate maintained values. |
| | C | Off Field Lighting Design | Lighting design drawings showing spill light levels in footcandles as specified in section 1.3 A. |
| | D | Photometric Report | Provide photometric report for a typical luminaire used showing candela tabulations as defined by IESNA Publication LM-35-02. Photometric data shall be certified by laboratory with current National Voluntary Laboratory Accreditation Program or an independent testing facility with over 5 years experience. |
| | E | Life Cycle Cost calculation | Document life cycle cost calculations as defined in the specification. Identify energy costs for operating the luminaires, maintenance cost for the system including spot lamp replacement, and group relamping costs. All costs should be based on 25 Years. |
| | F | Luminaire Aiming Summary | Document showing each luminaire's aiming angle and the poles on which the luminaries are mounted. Each aiming point shall identify the type of luminaire. |
| | G | Structural Calculations | Pole structural calculations and foundation design showing foundation shape, depth backfill requirements, rebar and anchor bolts (if required). Pole base reaction forces shall be shown on the foundation drawing along with soil bearing pressures. Design must be stamped by a structural engineer in the state of Texas. |
| | H | Control and Monitoring | Manufacturer shall provide written definition and schematics for automated control system to include monitoring. They will also provide examples of system reporting and access for numbers for personal contact to operate the system. |
| | I | Electrical distribution plans | If bidding an alternate system, manufacturer must include a revised electrical distribution plan including changes to service entrance, panels and wire sizing, signed by a licensed Electrical Engineer in the state of Texas. |
| | J | Performance Guarantee | Provide performance guarantee including a written commitment to undertake all corrections required to meet the performance requirements noted in these specifications at no expense to the owner. Light levels must be guaranteed per specification for 25 years. Constant light systems shall provide independent 3 rd party test data stamped by a registered engineer. |
| | K | Warranty | Provide written warranty information including all terms and conditions. |

| | | | |
|--|----------|---------------------|--|
| | L | Project References | Manufacturer to provide a list of project references of similar products completed within the past three years. |
| | M | Product Information | Complete set of product brochures for all components, including a complete parts list and UL Listings. |
| | N | Non-Compliance | Manufacturer shall list all items that do not comply with the specifications. |
| | O | Compliance | Manufacturer shall sign off that all requirements of the specifications have been met at that the manufacturer will be responsible for any future costs incurred to bring their equipment into compliance for all items not meeting specifications and not listed in item N – Non-Compliance |

Manufacturer:

Signature:

Contact Name:

Date: ____/____/____

**SECTION 27 01 00 - OPERATION AND MAINTENANCE (O&M) MANUALS
OF COMMUNICATIONS SYSTEMS**

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Compile product data and related information appropriate for Owner's operation and maintenance of products furnished under Contract. Prepare operating and maintenance data as specified in this Section and as referenced in other sections of specifications.
- B. Instruct Owner's personnel in operation and maintenance of equipment and systems.
- C. Submit three (3) electronic copies, on separate devices (USB Flash Drive or some type of pre-approved solid-state storage device), of complete O&M manuals in final form. The submitted manual shall be the system manufacturer's operations manual, supplemented with operations and maintenance instructions custom tailored for the system installed. Electronic documentation shall be provided in a non-proprietary PDF format, without password restrictions.
- D. Hard copies shall be provided upon request of the Owner, Architect, and/or Consultant.
- E. Recorded video of all training sessions shall be included in each copy, of each system's final submitted O&M.
- F. The final submitted manual shall include a sign-in sheet and owner/consultant signed acceptance of all training sessions.

1.2 ELECTRICAL OPERATING AND MAINTENANCE MANUAL SUBMITTAL SCHEDULE

- A. Thirty (30) days after receipt of reviewed submittals bearing the Project Technology Consultant's stamp of acceptance (including re-submittals), submit for review, an electronic copy of the first draft of the System's O&M Manual. This copy shall contain as applicable to the specific system, a minimum of the following:
 - 1. Table of Contents for each element
 - 2. Contractor information
 - 3. All shop drawings, coordination drawings and product data, bearing the Project technology Consultant's stamp of acceptance.
 - 4. All parts and maintenance manuals for items of equipment
 - 5. Warranties (without starting dates)
 - 6. Certifications that have been completed; submit forms and outlines of certifications that have not been completed
 - 7. Operating and maintenance procedures.
 - 8. Form of Owner's Training Program Syllabus (including times and dates)
 - 9. Control operations / equipment wiring diagrams
 - 10. Coordination Drawings
 - 11. Schedule of Speakers, Amplifiers, Sound Equipment, Etc.
 - 12. Schedule of Handsets and other Peripheral Devices, Etc.
 - 13. Schedule of Cable, Jacks, Outlets, Etc.
 - 14. Access Control Door Schedules
 - 15. Video Surveillance Camera Schedules
 - 16. Other required operating and maintenance information that are complete.
 - 17. Cable pathway layout drawings and station map, including through wall and

floor penetration locations and sleeve sizes.

- B. Copy will be returned to the Contractor within 15 days with comments for corrections.
- C. Submit the electronic completed manuals (hard copies upon request) in final form to the Project's Technology Consultant.
 - 1. Prior to substantial completion for Owner's use after the Owner accepts facility maintenance.
 - 2. Include all specified data, test reports, drawings, dated warranties, certificates, training videos. along with other materials and information.
- D. The Project's Technology Consultant shall review the manuals for completeness within 15 days.
- E. The Contractor shall be notified of any missing or omitted materials. The Manuals shall be reworked by the Contractor, as required, in the office of the Project's Technology Consultant. The manuals will not be retransmitted.
- F. Electronic and/or hard copies of the accepted manuals shall be delivered to the Owner prior to substantial completion.

PART 2 - PRODUCTS

2.1 BINDERS

- A. Upon the request for hard copies of the O&M manuals, the binders shall consist of the following configuration:
 - 1. Commercial quality black, 3-ring binders with clear, durable, cleanable plastic covers.
 - 2. Minimum ring size: 1"; Maximum ring size: 3".
 - 3. When multiple binders are used, correlate the data into related groupings.
 - 4. Label contents on spine and face of binder with full size insert. Label under plastic cover.

PART 3 - EXECUTION

3.1 SYSTEM OPERATION AND MAINTENANCE MANUAL

- A. Form for Manuals Submitted in Hard Copy Format:
 - 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 flyleaf 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.
 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 / normal operating instructions
 - 2) Regulation, control, stopping, shut down and emergency instructions
 - 3) 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. Manufacturer's printed operating and maintenance instructions.
- e. Original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance.
- f. Complete equipment field accessible wiring diagrams
- g. Each Contractor's coordination drawings
- h. 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 27.
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.

END OF SECTION

**SECTION 27 05 00 - COMMUNICATIONS BASIC MATERIALS, METHODS, AND
GENERAL PROVISIONS**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Except as modified in this Section, General Conditions, Supplementary Conditions, applicable provisions of Division 01 General Requirements, and other provisions and requirements of the Contract Documents apply to work of Division 27 Communications.
- B. Applicable provisions of this section apply to all sections of Division 27, Communications.
- C. The general provisions of the Contract and the requirements of the following Sections apply to the Work specified in this Section. See following sections for related general and specific requirements following sections shall associate with this specification as applicable.
 - 1. Division 26 in its entirety.
 - 2. Division 27 in its entirety.
 - 3. Division 28 in its entirety.
- D. The entire drawing and specification package apply to the work specified in the communication 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.

1.2 CODES AND STANDARDS

- A. All equipment and work performed shall comply with current and applicable Codes, Standards, Rules, Ordinances, Regulations, and Best Practices (both published and best practices) 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 (including those not specifically listed in this Specification). Applicable Codes and Standards shall consist of, but not be limited to the following:
 - 1. Americans with Disabilities Act (ADA)
 - 2. Authorities Having Jurisdiction (AHJ) - Local
 - 3. American National Standards Institute (ANSI)
 - 4. American Society of Testing and Materials (ASTM) *Communications Cables - B694, B736, D4565, D4566, D4730, D4731, D4732*
 - 5. Building Industry Consulting Services International (BICSI)
 - 6. Code of Federal Regulations - Title 47
 - 7. Electronics Industries Association (EIA) *Standard Test Procedures for Fiber Optic Fibers, Cables, Transducers, Connecting and Terminating Devices - EIA-455 Series*
 - 8. Federal Communications Commission (FCC) - Communications Act and FCC Rules
 - 9. Federal Information Processing Standards (FIPS) *Federal Building Standard for Telecommunications Pathways and Spaces - FIPS PUB 175, FIPS PUB 176*
 - 10. The Insulated Cable Engineers Association (ICEA) *Communications Cable Stands - P-47-434, S-56-434, S-80-576, S84-608, S-85-625, S-86-634, S-87-*

- 640, S-89-648, S-90-661, S-98-688, S-99-689, S-100-685
11. International Electro-technical Commission (IEC)
 12. Institute of Electrical and Electronic Engineers (IEEE) *Local Area Networks/Metropolitan Networks Standards Collection - LAN/MAN 802 Series*
 13. International Organization for Standardization (ISO) (ISO/IEC) *Premise Wiring Core and LAN/MAN Core Equivalents-11801, 8802, 14763-1*
 14. International Telecommunication Union (ITU-T) *Telecommunications Standardization*
 15. National Electrical Code (NEC) *National Electrical Code - NFPA 70*
 16. National Electrical Contractor's Association (NECA) *Standards of Installation*
 17. National Electrical Manufacturers Association (NEMA) *Performance Standard for Twisted Pair Premise Voice and Data Communications Cable-WC 63.1, WC 63.2, WC 66*
 18. National Electrical Safety Code (NESC)
 19. National Fire Protection Association (NFPA) - *National Fire Alarm Code NFPA 72, Life Safety Code NFPA 101*
 20. Society of Cable Telecommunications Engineers (SCTE)
 21. Local Accessibility Standards
 22. Telecommunications Industries Association (TIA) *(ANSI/TIA/EIA) Wiring and Cabling Standards - 526, 568, 569, 570, 571, 598, 606, 607, 758, TSB 31-B, 63, 67, 72, 75 and 95*
 23. Uniform Building Code (UBC)
 24. Underwriters Laboratories, Inc. (U.L.) - *497A, 910, 1077, 1863, 1283, 1459, 1604, 1651, 1681, 1690, 1778, 1977*

- B. Resolve any code violations discovered in contract documents with the Engineer prior to award of the contract. After Contract award, any correction or additions necessary for compliance with applicable codes shall be made at no additional cost to the Owner.
- C. This Contractor shall be responsible for being aware of and complying with asbestos NESHAP regulations, as well as all other applicable codes, laws and regulations.
- D. Obtain all permits required.

1.3 SUMMARY

- 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 a new and/or an extension of the existing installation, as shown in the associated specifications and drawings, complete in every respect.
- C. Provide complete and working Communications Systems including equipment, conduit, wiring, material, labor and training as described in this Specification and the Drawings. The Communications Systems Drawings and Specifications are the sole property of the Architect and are not to be duplicated, scanned, loaned or in any way made available to persons not designated as authorized by the Architect. All Communications Systems plans, and specifications are to be returned to the Architect following completion of bid.

1.4 CONTRACTOR'S QUALIFICATIONS

- A. An approved contractor for the work under this division shall be:
 - 1. A specialist in this field and have the personnel, experience, training, and skill, and the organization to provide a practical working system.
 - 2. Able to furnish evidence of having contracted for and installed not less than ten (10) systems of comparable size and type that have served their Owners satisfactorily for not less than 3 years.
 - 3. Perform work by persons qualified to produce workmanship of specified quality. Persons performing work shall be required to be licensed. Onsite supervision shall have minimum of the following:
 - a. Licenses, as applicable to the system being installed
 - b. Manufacturer's Certifications
 - 1) Firm Certification
 - 2) Installer Certification
 - 3) Programmer's Certification
 - 4) System Designer Certification.

1.5 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 Consultant for review. No departures shall be made without prior written acceptance of the Consultant.
- 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 Consultant in writing, shall be performed or furnished. In the case that 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. The approximate locations of system equipment and components are indicated on the Drawings. These Drawings are not intended to give complete and accurate details in regard to location of equipment, field devices, etc. Exact locations are to be determined by actual measurements at the building and will in all cases be subject to the Review of the Owner or Consultant, who reserves the right to make any reasonable changes in the locations indicated without additional cost to the Owner.
- E. Items specifically mentioned in the Specifications but not shown on the Drawings and/or items shown on 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.
- F. Any discrepancies between the Contract Documents and actual job site conditions shall be reported to the Owner or Consultant, so that they will be resolved prior to the bidding, where this cannot be done at least 7 working days prior to bid; the greater or costlier of the discrepancy shall be bid. All labor and materials required to perform the work described shall be included as part of this Contract.
- G. It is the intention of this Section of the Specifications, and associated drawings, to outline minimum requirements to furnish the Owner with a turnkey and fully operating system in cooperation with other trades.

- H. The contract documents are schematic in nature in that they are only to establish scope and a minimum level of quality. They are not to be used as actual working construction drawings. The actual working construction drawings shall be the shop drawings accepted by project's consultant.
- I. 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 project's consultant 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.
- J. These documents are conceptual in nature. It shall be the responsibility of the approved installer to furnish a complete and functional system, including the items shown on the drawings, in the specifications, and items not designated in either. The installer's shop drawings and product data submittals shall represent a complete system and documents accepted by the project's consultant shall not relieve the installer from being required to provide any materials, equipment, or labor to furnish a complete and functional system as recognized by the Project's Technology Consultant and the Owner.

1.6 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, ordinances, and standards; 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 closed ceiling space and/or furred chases unless specifically noted or indicated to be exposed. Work shall be installed to avoid crippling of structural members. 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 Consultant. The Consultant 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.
- E. Consider space limitations imposed by contiguous work in selection and location of equipment and material. Do not provide equipment or material that is not suitable in this respect.

1.7 RELATION WITH OTHER TRADES

- A. Carefully study all matters and conditions concerning the project. Submit notification of conflict in ample time to prevent unwarranted changes in any work. Review other Divisions of these specifications to determine their requirements. Extend electrical services and final connections to all items requiring same.
- B. Because of the complicated relationship of this work to the total project, conscientiously study the relation and cooperate as necessary to accomplish the full intent of the documents.
- C. Where cabling pass through walls or floors, metal sleeves shall be provided and shall be sealed to prevent spread of fire and smoke. In walls, they shall extend 3" beyond the finished surface. In pipe chases, they shall extend 8" inches above floor slab and be cemented in a watertight manner. Size of these sleeves shall be at least as required to maintain a maximum 40% conduit fill ratio. 1/2 inch greater than outside diameter of the conduit.
- D. Locate and size openings required for installation of work specified in this Division in sufficient time to prevent delay in the work.
- E. Refer to other Divisions of the specifications for the scope of required connections to equipment furnished under other Division. Determine from the General Contractor / Construction Manager for the various trades, the Owner, and by direction from the Architect / Engineer, the exact location of all items. The construction trades involved shall furnish all roughing-in drawings and wiring diagrams required for proper installation of the electrical work.
 - 1. Make final connections to all communications equipment indicated on the drawings, except as noted.
- F. Request all Shop Drawings required in ample time to permit proper installation of all electrical provisions.
- G. Extend services as indicated to the various items of equipment furnished by others. Rough-in for the various items and make final connections ready for operation upon placing of the equipment.

1.8 CONCEALED AND EXPOSED WORK

- A. When the word "concealed" is defined as hidden from sight as in chases, furred spaces or above ceilings. "Exposed" is defined as open to view, in plain sight.

1.9 GUARANTEE

- A. Guarantee work for a minimum of two years or as noted longer elsewhere from the date of substantial completion of the project. During that period make good any faults or imperfections that may arise due to defects or omissions in material, equipment or workmanship. At the Owner's option, replacement of failed parts or equipment shall be provided.

1.10 MATERIAL AND EQUIPMENT

- A. Furnish new and unused materials and equipment meeting the requirements of the paragraph specifying acceptable manufacturers. Where two or more units of the same type or class of equipment are required, provide units of a single manufacturer.

1.11 NOISE AND VIBRATION

- A. Select equipment to operate with minimum noise and vibration. If noise or vibration is produced or transmitted to or through the building structure by equipment, piping, ducts or other parts of work, and judged objectionable by the Owner, Architect, or Engineer, rectify such conditions at no additional cost to the Owner. If the item of equipment is judged to produce objectionable noise or vibration, demonstrate at no additional cost that equipment performs within designated limits on a vibration chart.

1.12 ACCEPTABLE MANUFACTURERS

- A. Manufacturers names and catalog number specified under sections of Division 27 are used to establish standards of design, performance, quality and serviceability and not to limit competition. Equipment of similar design, equal to that specified, manufactured by a named manufacturer shall be acceptable on approval. A request for prior approval of equipment not listed must be submitted ten (10) days before proposal due date. Submit complete design and performance data to the Architect. The Architect and Owner issue approvals of acceptable manufacturers as addenda to the Construction Proposal Documents.
- 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.

1.13 UTILITIES, LOCATIONS AND ELEVATIONS

- A. Locations and elevations of the various utilities included within the scope of this work:
 - 1. Obtained from utility maps and other substantially reliable sources.
 - 2. Are offered separate from the Contract Documents as a general guide only without guarantees to accuracy.
- B. Examine the site and verify the location and elevation of all utilities and of their relation to the work. Existing utilities indicated on the site plans are for reference only and shall be field verified by the Contractor with the respective public or private utility.

1.14 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.
- B. It is the responsibility of the Contractor to compare the scale of all electrical drawings with the scale of the architectural drawings and make adjustments to all electrical drawings which have the incorrect drawing scale so that his material takeoffs are not in error due to an incorrectly labeled drawing scale and his proposal is complete.

1.15 ABBREVIATIONS AND DEFINITIONS

| | |
|------|------------------------------|
| A/V | Audio/Visual |
| AWG | American Wire Gauge |
| BCR | Building Communications Room |
| CATV | Cable Antenna Television |
| CCTV | Closed Circuit Television |

| | |
|----------|--|
| CMP | Communications Media Plenum |
| CMR | Communications Media Riser |
| dB | Decibel |
| EMI | Electromagnetic Interference |
| ER | Equipment Room |
| FACP | Fire Alarm Control Panel |
| FCR | Floor Communications Room |
| Gbps | Giga Bits Per Second |
| Hz | Hertz |
| IC | Intermediate Cross-connect |
| IDF | Intermediate Distribution Frame |
| IM | Information Management |
| IS | Information Systems or Information Services (also see MIS) |
| IT | Information Technology |
| Km | Kilometer |
| LCD | Liquid Crystal Display |
| LED | Light Emitting Diode |
| M | Micron |
| MATV | Master Antenna Television (A.K.A. Main Antenna Television) |
| Mbps | Mega Bits Per Second |
| MC | Main Cross-connect |
| MDF | Main Distribution Frame |
| MHz | Megahertz |
| MIS | Management Information Systems or Services |
| NEXT | Near-End Cross Talk |
| nm | Nanometer |
| OFN | Optical Fiber Non-conductive |
| OFNP | Optical Fiber Non-conductive Plenum |
| OFNR | Optical Fiber Non-conductive Riser |
| OTDR | Optical Time Domain Reflectometer |
| PBX | Private Branch Exchange |
| POS | Point of Sale |
| PSELFEXT | Power Sum Equal Level Far-End Cross Talk |
| PSNEXT | Power Sum Near-End Cross Talk |
| SMATV | Satellite Main Antenna Television |
| TC | Telecommunications Closet (Now referred to as TR) |
| T.O. | Telecommunications Outlet |
| TR | Telecommunications Room (A.K.A. TC - Telecommunication Closet) |
| UTP | Unshielded Twisted Pair Wire |

Definitions:

Administration Subsystem - Cable, connectors, cross-connect and inter-connect hardware, patch cords, and other equipment that allows easy reconfiguration of the telecommunications system to accommodate personnel and floor plans changes.

Campus Backbone Subsystem - Connects telecommunications processing equipment in different buildings on the same campus.

Communications Cabling - Any fiber optic, copper, coaxial or other transmission media used for transmitting or receiving communications systems data.

Communications System - Communications Systems and associated wired or

wireless interconnection.

Communications Drawings - All floor plans, elevations, details, schematics, block diagrams, legends, tables, notes or attachments associated with any or all of the Communications Systems.

Distribution Cable - The telecommunications UTP wiring between the telecommunications room and the outlet connectors.

Equipment Subsystem - Telecommunications cable, connectors, support hardware, blocks, and protective devices that serve to connect the network interface and the backbone subsystem through the administrative subsystem.

Horizontal Subsystem - Telecommunications cable, outlets and distribution cords that extend the riser backbone from the administrative points in the TRs to workstations.

Information Systems - Software systems including operating systems, programs, data manipulation and management systems, control software and various forms of proprietary and off-the-shelf software.

Information Technology - The practical application of knowledge associated with designing, installing and maintaining the equipment, hardware and infrastructure utilized for control, distribution, or display of telecommunications, audio, video and data signals. Because computers are central to information management, computer departments within companies and universities are often called (IT Departments) and are responsible for MIS or IS personnel and services.

Low Voltage Wire - Wire or cable used for one or more systems that operate on 24 volts or less. Low Voltage Wire is used to install and interconnect one or more of the Communications Systems. Low Voltage Wire includes patch cords, jumpers and all portions of cable or wire used to make the Communications Systems operational or for system communications.

Management Information Systems - A class of software that provides managers with tools for organizing and evaluating their department. Typically, MIS systems are written in COBOL and run on mainframes or minicomputers. Within companies and large organizations, the department responsible for computer systems is sometime called the MIS department. Another name for MIS is Information Services (IS).

Multiplexer - A communications device that multiplexes (combines) several signals for transmission over a single medium. A multiplexer is sometimes called a "mux". A demultiplexer is required to complete the process by separating multiplexed signals from a transmission line. Frequently a multiplexer and demultiplexer are combined into a single device capable of processing both outgoing and incoming signals.

Riser Backbone Subsystem - Telecommunications cable, splice enclosures, and associated hardware that provide the main cable routes in a building. It interconnects building floors and larger areas of a single floor. It also interconnects administrative points in satellite TRs to the administrative points in the building main equipment room.

Station Cable - The wiring between the outlet connections and the work area equipment.

Communications Systems - One or more of the following and associated equipment:

Data/Networking Systems, Telecommunications Systems, Paging / Intercom Systems, Clock/Control Systems, Master Antenna Television Systems, Cable Antenna Television Systems, Broadcast Video Systems, Audio/Visual Presentations Systems, Microwave/Wireless Systems.

Telecommunications - The transmission, emission or reception of signs, signals, images, sound or intelligence of any nature by wire, radio, optical or other technical transmission system.

Work Area - Location of an employee or student and their data/telecommunications equipment or devices.

Work Area Subsystem - Station mounting cords, extension cords, connectors, adapters, and interface units that provide physical and electrical connectivity between workstation equipment and the horizontal subsystem.

1.16 QUALITY ASSURANCE

A. Equipment Standards:

1. System and all components shall be brand new stock from manufacturer.
2. All electronics shall be 100% solid state.
3. System and all components shall bear a UL Label.

B. Contractor Qualifications:

At the time of Proposal, the Contractor shall:

1. Have manufactured, supplied or installed at least three (3) other systems of similar size, complexity, and general operation as the systems described in these specifications. The Contractor shall furnish in writing to Architect proof of compliance with this paragraph at the time of proposal.
2. Hold all legally required Texas State Contractor's licenses necessary to accomplish the installation and activation of the described system at the facilities indicated. The Contractor shall submit copies of licenses to the Architect prior to the start of work
3. Hold all legally required state registrations to meet local requirements for submittal drawings.
4. Have a local office within fifty (50) miles of the project site staffed with factory trained technicians who have experience on systems of similar complexity and function as the systems described in these specifications. These technicians shall be fully capable of system engineering support, installation supervising, system start-up, and providing the Owner with training and service on both hardware and software for the systems specified.
5. Certify complete and total compliance with the provisions of these specifications by letter or submittal of the proposal response forms, signed by an officer of the corporation, or a principal if other ownership currently exists. In addition, the letter or forms shall include a complete listing of exceptions, if any.

1.17 SUBMITTALS

A. Provide SUBMITTALS according to Division 01 and the following.

B. Requirements:

1. Submit paragraph-by-paragraph specification review indicating compliance or deviation with explanation.
2. Submit proof that all system components and cables are U.L. Listed.

3. An equipment list with names of manufacturers, model numbers, and technical information on all equipment proposed. Clearly mark exact model number proposed to be installed.
4. Product technical information sheets for each principal component in the proposed system, including cable, wire, terminal marking, and wire marking material.
5. Certification from the manufacturer stating that the system Contractor is an authorized distributor or installer of the proposed system when such certifications exist.
6. A statement listing every technical and operational parameter wherein the submitted equipment varies from that which was originally specified. If the submitter fails to list a particular variance and his submittal is accepted but is subsequently deemed to be unsatisfactory because of the unlisted variance, the submitter shall replace or modify such equipment at once and without cost to the Owner.

1.18 EXAMINATION OF SITE

- A. The Contractor shall have visited the site and familiarized himself with all existing conditions prior to submitting his proposal and shall be prepared to carry out the work within the existing limitations. Failure or neglect to do so shall not relieve the Contractor of his responsibilities not entitle him to additional compensation for work overlooked and not included in his proposal.
- B. The Contractor shall confirm the availability of the proper power source for each piece of specified equipment, through site visits and Drawings as necessary. Where proper power does not exist, the Contractor shall provide the required power, circuits, outlets, conduits, and wire as specified under Division 26.

1.19 DATA ACCURACY

- A. Absolute accuracy of information regarding existing conditions cannot be guaranteed. The Drawings and Specifications are for the assistance and guidance of the Contractor and exact locations, distances, elevations, etc., shall be governed by actual field conditions. Where variations from the contract documents are required, such variations shall be approved by the Architect / Owner.

1.20 SECURITY

- A. The Contractor is responsible for complying with all of the Owner's and facility security's requirements to prevent theft or damage to equipment, tools and materials. If any deviation from facility security requirements is necessary, approval for such deviation shall be coordinated with the Owner.
- B. The Contractor shall not disclose any confidential information of the Owner. The Contractor acknowledges that such action is highly injurious and can do damage to the Owner. The Contractor will agree to and comply with the standard policies and provisions of the Owner regarding outside Contractors and Consultants.

1.21 UTILITIES

- A. It shall be the responsibility of the Contractor to provide all temporary connection and cables, lighting, light stands and power. The facilities shall be used in accordance with all applicable regulations regarding operations, safety and fire hazards of the governmental Authorities Having Jurisdiction, provided they are not used in a wasteful

manner.

1.22 PERMITS

- A. All permits required for the specified performance and completion of the work shall be secured by the Contractor. These permits shall be presented and reviewed at the initial project progress meeting.

1.23 NOTIFICATION

- A. The Contractor shall not shut off any existing systems. The Contractor shall give the Owner at least ten (10) calendar day's notice of any requirements to shut off or interference with existing alarm, regulating, computer or other service systems. The Owner will arrange and execute any shutdown. All work such as splicing, connections, etc., necessary to establish or re-establish any system shall be completed by the Contractor in close coordination with the Owner.

1.24 INTERFERENCES WITH THE OWNER

- A. Transportation and storage of materials at the facility, work involving the facility, and all other matters affecting the habitual use by the Owner of its buildings, shall be conducted so as to cause the least possible interference, and at times and in a manner acceptable to the Owner. The Contractor shall make every effort to delivery equipment per the schedule required by the project.

1.25 PROJECT RECORD DOCUMENTS

- A. Maintain at the job site a separate set of white prints (blue line or black line) of the contract drawings for the sole purpose of recording the "as-built" changes and diagrams of those portions of work in which actual construction is significantly at variance with the contract drawings. Mark the drawings with a colored pencil. Prepare, as the work progresses and upon completion of work, reproducible drawings clearly indicating locations of various major and minor feeders, equipment, and other pertinent items, as installed. Record underground and under-slab cables installed, dimensioning exact location and elevation of such installations.
- B. At conclusion of project, obtain without cost to the Owner, electronic AutoCAD 2014 or later / Revit CAD files of the original drawings and transfer as-built changes to these. Provide the following as-built documents including all contract drawings regardless of whether corrections were necessary and include in the transmittal: "2 sets of CDs and prints for Owner's use, one set of CDs, prints, and mylars for Architect / Engineers Records". Delivery of these as-built electronic, reproducible and prints is a condition of final acceptance.
 - 1. 3 sets of electronic AutoCAD (2014 dwg or later) / Revit CAD drawing files, on CD-ROM media, of each contract as-built drawing.
 - 2. One reproducible Dayrex mylar film positive of each contract as-built drawing.
 - 3. Three sets of blue or black-line prints of each contract as-built drawing.
- C. 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 conduit and cables, etc that were deviated from construction

drawings.

6. Indicate exact location of all underground communications raceways, and elevations.
7. Correct schedules to reflect (actual) equipment furnished and manufacturer.
8. During the execution of work, maintain a complete set of Drawings and specifications upon which all locations of equipment, devices, and all deviations and changes from the construction documents in the work shall be recorded.
9. Exact location of all communications equipment in building. Label panel schedules to indicate actual location.
10. Exact location of all communications equipment in and outside of the building.
11. Location, size and routing of all communications cables, conduits, equipment, etc. shall be accurately and neatly shown to dimension.
12. Exact location of all roof mounted equipment, wall, roof and floor penetrations.
13. Cloud all changes.

1.26 OPERATING TESTS

- A. After all communications systems have been completed and put into operation, subject each system to an operating test under design conditions to ensure proper sequencing and operation throughout the range of operation. Tests shall be made in the presence of the Architect / Engineer and Owner. Provide minimum 24-hour advance notice of scheduling of all tests. Make adjustments as required to ensure proper functioning of all systems. Special tests on individual systems are specified under individual sections. Submit 3 copies of all certifications and test reports adequately in advance of completion of the work to allow for remedial action as required to correct deficiencies discovered in equipment and systems.

1.27 WARRANTY

- A. All equipment shall be covered for the full manufacturers warranty period and systems shall be warranted by the Contractor for a period of two years commencing with the filing date of substantial completion. The Warranty shall cover all costs for warranty service, including parts, labor, prompt field service, pick-up, transportation, delivery, reinstallation, and retesting. A contract for service shall cover the period starting with the first expected activation of each system and shall continue without interruption to cover the period to the end of the two-year warranty as defined above. The end of the warranty period shall be handled such that a smooth transition to a maintenance agreement with the Owner shall be achieved with no lapse in coverage.
- B. Submit 3 copies of all warranties and guarantees for systems, equipment, devices and materials. These shall be included in the Operating and Maintenance Manuals.

1.28 BUILDING CONSTRUCTION

- A. It shall be the responsibility of the sub-contractor to consult the Architectural and Engineering drawings, details and specifications and thoroughly familiarize himself as to the construction and all job-related requirements. All construction trades shall cooperate with the General Contractor / Construction Manager job site superintendent and lay out work so that all piping, cables, pathways, raceways, and other items are placed in the walls, furred spaces, chases, etc., so that there shall be no delay in the job.

1.29 TEMPORARY FACILITIES

- A. General: Refer to Division 01 for general requirements on temporary facilities.
- B. Temporary Wiring: Temporary power and lighting for construction purposes shall be provided under Division 26. Installation of temporary power shall be in accordance with NEC Article 305.
- C. Temporary facilities, wire, lights and devices are the property of this Contractor and shall be removed at the completion of the Contract.

1.30 EXTRA MATERIALS

- A. Keys: Provide three (3) sets of all keys for system cabinets.

PART 2 - PRODUCTS

2.1 WORK INCLUDED

- A. All materials listed in PART 2 - PRODUCTS of this Division Sections and on the Drawings shall be provided by the Contractor unless specifically excluded or modified in other portions of this Specification or Addendums.

2.2 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.

2.3 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.

2.4 MANUFACTURE'S INSTRUCTIONS

- A. The Contractor is responsible for furnishing the proper Communication 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 Consultant, in writing, of any conflict between the Contract Documents and the manufacturer's recommendations and shall obtain, from the Consultant, 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 Consultant.

2.5 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.

2.6 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.
- B. All electronic equipment, containing sealed lead acid batteries or gel cells, shall be stored in climate-controlled area until installed or reinstalled. Do not store in non-climate controlled connex storage units.
- C. Storage is to be provided and secured by the contractor. In the event that the Owner should agree to furnish storage space, security of the space and its contents shall remain the responsibility of the contractor.

2.7 CONDITION OF MATERIALS

- A. All materials required for the installation of the Communication 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 installed, or while being tested, until time of final acceptance, shall be replaced by this Contractor without extra cost to Owner.

2.8 NAMEPLATES

- A. Factory assembled components and equipment shall be provided with be factory stamped labeling. Labeling will have information required to specifically identify the component and/or equipment in the future such as the manufacturer's name, catalog number, serial number, etc. All data on the labels shall be legible at the time of final inspection.

2.9 ACCESS DOORS

- A. Wherever access is required in walls or ceilings to concealed junction boxes, pull boxes, equipment, etc., installed under this Division, furnish a hinged access door and frame with flush latch handle to another Division for installation. Doors shall be as follows:
 - 1. Plaster Surfaces: Milcor Style K.
 - 2. Ceramic Tile Surfaces: Milcor Style M.
 - 3. Drywall Surfaces: Milcor Style DW.
 - 4. Install panels only in locations approved by the Architect.

2.10 SPACE LIMITATIONS

- A. Equipment shall be chosen which shall properly fit into the physical space provided and shown on the drawings, allowing ample room for access, servicing, removal and replacement of parts, etc. Adequate space shall be allowed for clearances in

accordance with applicable codes and standards. Physical dimensions and arrangement of equipment shall be subject to the approval of the Consultant.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. This project has a critical path, which must be closely followed in order to meet the completion date. The Contractor shall review the proposed schedule at the Award of Contract meeting and be prepared to staff his work force according to the schedule constraints presented at that time.
- B. Aesthetics are an important consideration in this installation. All components shall be installed so as to have aesthetically pleasing results as determined by the Owner and Architect. Actual locations of all visible components shall be coordinated in advance with the Owner and Architect.
- C. Install, make fully operational and test the system as indicated on the Drawings and in the Specifications. Where information is not available the worst-case condition must be assumed to ensure a complete, functional system.
- D. Any interfacing with other systems shall be the Contractor's responsibility under this contract, and the details, both logical and physical, of such interfaces shall be reflected in the Submittals and As-Built drawings.
- E. If appropriate, interfaces with the Owner's Data Network, Telecommunications and Communications System shall be coordinated with the Owner and Architect.
- F. All necessary back boards, back-boxes, pull-boxes, connectors, supports, conduit, cable and wire shall be furnished and installed to provide a complete and reliable system. Exact location of all backboards, boxes, conduit and wiring runs shall be presented to the Owner / Architect for approval in advance of any installation. Provide as required and as specified in Division 26.
- G. Where required provide 120-VAC, 60 Hz power from nearest electrical panel through a junction box, to the system devices. Provide as required and as specified in Division 26.
- H. Where required, install conduit, cable and wire parallel and square with building lines, including raised floor areas. Conduit fills shall not exceed 40%.
- I. Ground busses shall be provided in each any room with communication equipment.
- J. All equipment shall be mounted with sufficient clearance to minimize EMI as well as meet all applicable codes and facilitate observation and testing. Securely hand and/or fasten with appropriate fittings to ensure positive grounding, free of ground loops, throughout the entire system. Units shall be installed parallel and square to building lines.
- K. Communications grounding system shall be a single point grounding from the building entrance electrical ground to each Communications room.
- L. 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 communications grounding system. The conductors shall be a # 6awg solid

with a green jacket

- M. Quiet and vibration-free operation of all equipment is a requirement of this installation. Properly adjust, repair, balance or replace any equipment producing objectionable (in the judgment of the Owner or Architect) noise or vibration in any of the occupied areas of any building and provide additional brackets and bracing if necessary. Any such additions or changes shall be at no additional cost to the Owner.
- N. Installation shall comply with the CODES AND STANDARDS portion of this Section. Where more than one code or regulation if applicable, the more stringent shall apply.
- O. Where new equipment is replacing old equipment, the Contractor is responsible for removing and disposing of the old equipment and doing whatever repair work is necessary as specified by the Owner / Architect.
- P. Install firestopping, as specified in Division 26 for all penetrations in slabs and firewalls to meet code at the completion of work and prior to final testing demonstration to the Owner.
- Q. The installation shall be performed in a professional manner.
- R. On a daily basis, clean up and deposit in appropriate containers all debris from work performed under the appropriate specification sections. Stack and organize all parts, tools and equipment when not being used.
- S. Preparation, handling and installation shall be in accordance with the Manufacturer's written instructions and technical data appropriate to the product specified.
- T. All work shall conform to the National Electrical Contractor's Association "Standard of Installation" for general installation practice.
- U. At the conclusion of the installation, all work areas, including all enclosures and boxes, shall be vacuumed and cleaned to remove all debris and grease.

3.2 COORDINATION WITH OWNER / ARCHITECT

- A. Close coordination with the Owner / Architect is vital to achieve a complete, aesthetically pleasing job. The Contractor shall ensure that the Owner / Architect is kept fully apprized of job progress.

3.3 CUTTING, PAINTING, AND PATCHING

- A. Structural members shall not be drilled, bored or notched in such a manner that shall impair their structural value. Cutting of holes in structural members, if required, shall be done with core drills and only with the specific approval of the Owner / Architect for each instance.
- B. All walls that require cutting or repair during the installation process shall be returned to their original condition, including the matching of colors and finishes to the satisfaction of the Owner / Architect, and at no additional cost to the Owner.

3.4 WIRE AND CABLE

- A. All low voltage cable shall be low smoke plenum rated, limited energy, with 300-volt insulation.

- B. All wires in exposed areas shall run through conduit as specified in Division 26.
- C. Provide conduits, cable trays, raceways, wireways, boxes and outlets as specified in Division 26.
- D. After installation, and before termination, all wiring shall be checked and tested to insure there are no grounds, opens, or shorts on any conductors. In addition, all wires between buildings or underground and all coax cables shall have insulation tested with a megohmmeter (megger) and a reading of greater than 20 megohms shall be required to successfully complete the test.
- E. Run wires continuously from termination to termination without splices.
- F. Wire and cable shall be supported in each equipment and terminal cabinet and in each terminal and pull box in vertical risers and horizontal runs with wire duct and strap-type supports. At any point where wire duct is required for good wire management, whether shown on elevations or not, install appropriate duct. Where terminal boards are used, wire ducts shall be supplied on both sides and at no time shall wires cross over terminal boards. Arrange cables neatly to allow inspection, removal and replacement. Lace cables as required. Spot tie wire bundles with plastic cable ties and securely affix to panels. If screw type terminals are specified, terminal strip connections shall be locking, tongue style, pressure crimp, and solderless spade lug.
- G. Visually inspect wire and cable for faulty insulation prior to installation. Protect cable ends at all times with acceptable end caps except during actual termination. At no time shall any coaxial cable be subjected to a bend less than a 6-inch radius. Protect wire and cable from kinks. Install 1 pull rope for all 2" or larger sized conduits.
- H. Provide plastic bushings and strain relief material at all conduit exit points and where necessary, to avoid abrasion of wire and excess tension on wire and cable.
- I. Cables above accessible ceilings shall not rest on ceiling tiles. Use Velcro tie wraps, J-hooks or D-rings to hold cables. Provide independent support for all cables. Support is to be from building structure (do not support from pipes or conduits). Communications cables shall not tie off on HVAC supports, all-thread, ceiling grid hanger wire or electrical / mechanical piping system.
- J. Ground and bond equipment and circuits in accordance with NEC and Division 26.

3.5 IDENTIFICATION AND TAGGING

- A. All cables, wires, wiring forms, terminal blocks and terminals shall be identified by labels, tags to other permanent markings in accordance with TIA/EIA-606. The markings shall clearly indicate the function, source, or destination of all cabling, wiring and terminals. All cables and wires shall be identified, utilizing heat-shrink, machine printed, polyolefin wire markers (Brady Type B-32 *or equal*). Handwritten tags are not acceptable.
- B. Should a situation arise where the wire tagging format as shown on the drawings cannot be used, a substitute format shall be submitted which complies with the intent to provide documentation that will permit end-to-end tracing of all Communications Systems wiring.

- C. All panels shall be provided with permanently attached engraved lamacoid labels with identifying names and functions. All terminal points shall be appropriately labeled. Labels shall be consistent in form, color, and typeface throughout the system and all must contain the name of the system or subsystem as part of the label textual information. Design, color, font and layout shall be coordinated with, and approved by, the Owner.
- D. Identification of Equipment:
1. All major equipment shall have a manufacturer's label identifying the manufacturer's address, equipment model and serial numbers, equipment size, and other pertinent data. Take care not to obliterate this nameplate. The legend on all nameplates or tags shall correspond to the identification shown on the Operating Instructions.
 2. A black-white-black 3 layer laminated plastic engraved identifying nameplate shall be permanently secured to each wireway, terminal cabinet, and communications (voice, data, video) cabinet or rack.
 - a. Identifying nameplates shall have 1/2-inch high, engraved letters. For equipment designation and 1/4-inch letters indicating source circuit designation, (i.e.: "IDF(FCR) XXYY –served from MDF (BCR) XXGG).
 3. Permanent, waterproof, black markers shall be used to identify each communications grid junction box, clearly indicating the type of system available at that junction box.
 4. Pull Boxes: Field work each with a nameplate showing identity, and identifying equipment connected to it. Nameplates shall also indicate where pull box is fed from.
 5. Communication hardware located above accessible ceilings: Provide 1/2-inch high black name plate with white 1/4-inch letters glued to bottom of t-grid ceiling below hardware located above ceiling. Identification shall be as short as possible yet identifying device above ceiling, i.e. "A/V-EQ".
- E. Prohibited Markings: Markings intended to identify the manufacturer, vendor, or other source from whom the material has been obtained are prohibited for installation in public, tenant, or common areas within the project. Also prohibited are materials or devices that bear evidence that markings or insignias have been removed. Certification, testing (example, Underwriters Laboratories), and approval labels are exceptions to this requirement.
- F. Warning Signs: Provide warning signs where there is hazardous exposure associated with access to or operation of communications facilities. Provide text of sufficient size to convey adequate information at each location; mount permanently in an appropriate and effective location. Comply with industry standards for color and design.
- G. Wire and Cable Labeling: Provide wire markers on each conductor in all boxes, pull boxes, gutters, wireways. Identify with drop/circuit number.
- H. Underground Warning Tape: Thomas and Betts or approved equal. Six-inch wide plastic tape, colored red or orange with suitable warning legend describing buried communications lines. All underground conduits shall be so identified. Tape shall be buried at a depth of 6-inches below grade and directly above conduits or ductbanks. Provide magnetic marking tape below all underground conduits.

3.6 CUTTING AND PATCHING

- A. General: Comply with the requirements of Division 01 for the cutting and patching of other work to accommodate the installation of electrical work. Except as authorized by

the Architect / Engineer, cutting and patching of electrical work to accommodate the installation of other work is not permitted.

3.7 INSTRUCTION OF OWNER'S PERSONNEL

- A. Before proceeding with the instruction of Owner Personnel, prepare a typed outline in triplicate, listing the subjects that will be covered in this instruction, and submit the outline for review by the Owner. At the conclusion of the instruction period obtain the signature of each person being instructed on each copy of the reviewed outline to signify that he has a proper understanding of the operation and maintenance of the systems and resubmit the signed outlines.
- B. Prior to substantial completion, conduct an on-site training program to instruct Owner's operating personnel in the operation and maintenance of the communications systems.
 - 1. Provide the training during regular working day.
 - 2. The Instructors shall be experienced in their phase of operation and maintenance of the systems and with the project.
- C. Time to be allocated for instructions.
The Contractor shall furnish the services of factory trained specialists to instruct the Owner's operating personnel. The Owner's operator training shall include training as specified per system specification,
 - 1. Minimum of four (4) hours dedicated instructor time
 - 2. 2-hour sessions on different, non-consecutive days
 - 3. Additional instruction time for specific systems as specified in other Sections.
- D. Before on-site training, submit the program syllabus; proposed time and dates; for review and approval, minimum 48 hours prior to proposed training time and date.
 - 1. One copy to the Owner
 - 2. One copy to the Architect / Engineer
- E. The Owner shall provide a list of personnel to receive instructions and shall coordinate their attendance at the agreed upon times.
- F. Use operation and maintenance manuals as the basis of instruction. Review manual with personnel in detail. Explain all aspects of operation and maintenance.
- G. Demonstrate start-up, operation, control, adjustment, troubleshooting, servicing, maintenance, and shut down of each item of equipment.
- H. Demonstrate equipment functions (both individually and as part of the total integrated system).
- I. Prepare and insert additional data in the operating and maintenance manuals when the need for additional data becomes apparent during instructions.
- J. Submit a report within one week after completion of training. List time and date of each demonstration, hours devoted to the demonstration, and a list of people present, with their respective signatures.
- K. 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.

- L. Provide a copy of the report and the certificate in an appropriately tabbed section of each Operating and Maintenance Manual.

3.8 OPENINGS

- A. Framed, cast or masonry openings for boxes, equipment or conduits are specified under other divisions. Drawings and layout work for exact size and location of all openings are included under this division.

3.9 OBSTRUCTIONS

- A. The drawings indicate certain information pertaining to surface and subsurface obstructions, which has been taken from available drawings. Such information is not guaranteed, however, as to accuracy of location or complete information.
 - 1. Before any cutting or trenching operations are begun, verify with Owner's representative, utility companies, municipalities, and other interested parties that all available information has been provided.
 - 2. Should obstruction be encountered, whether shown or not, alter routing of new work, reroute existing lines, remove obstruction where permitted, or otherwise perform whatever work is necessary to satisfy the purpose of the new work and leave existing services and structures in a satisfactory and serviceable condition.
- B. Assume total responsibility for and repair any damage to existing utilities or construction, whether or not such existing facilities are shown.

3.10 VANDAL RESISTANT DEVICES

- A. Where vandal resistant screws or bolts are employed on the project, deliver to the Owner 2 suitable tools for use with each type of fastener used.
- B. Proof of delivery of these items to the Owner shall be included in the Operating and Maintenance Manuals.

3.11 PROTECTION

- A. Protect work, equipment, fixtures, and materials. At work completion, work must be clean and in original manufacturer's condition.
- B. Do not deliver equipment to this 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 shall be rejected, and the contractor is obligated to furnish new equipment of a like kind at no additional cost to the Owner.

3.12 EQUIPMENT BACKBOARDS

- A. Backboards: $\frac{3}{4}$ inch, fire retardant, exterior grade plywood, painted gray, both sides.
 - 1. Provide minimum of two 4-ft. by 8-ft. sheets of plywood for each location shown.
 - 2. Provide minimum of two 4-ft. by 4-ft. sheets of plywood for each communications location.

3.13 SITE MANAGEMENT RESPONSIBILITY

- A. The Contractor shall provide an on-site Project Manager as defined in CONTRACTOR'S QUALIFICATIONS portion of this Section.

3.14 DEMOLITION AND RELOCATION

- A. 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.
- B. 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 Consultant. Where items scheduled for relocation and/or reuse are considered unsuitable for reuse, the Contractor shall so notify the Consultant 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 no additional cost to the Owner or the Consultant.
- C. 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.
- D. 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 Consultant.

3.15 EXISTING SYSTEM TESTING

- A. Contractor shall have each low voltage system tested prior to the commencement of construction. Systems shall include all systems that fall under the Division 27 umbrellas, as identified in the Division 27 of the Construction Specifications Institute (CSI) current Master Format . Test shall include the functionality of all field devices and equipment. Any failures or items found to be functioning not to specification, shall be reported prior to construction. Any items found to be improperly or non-functioning upon the completion of the project, shall be replaced and/or repaired, by the contractor, at no additional cost to the project or the owner.
- B. Contractor shall document the location and any ID tag, MAC address, IP address, or bar code of any existing device that is to be removed from its current location. Devices

that are to remain, shall be reinstalled in the exact location that they reside in prior to construction, unless noted otherwise.

- C. Any individual/firm that will be removing, relocating, reinstalling, or tampering with any devices; shall be licensed by the state and certified by the manufacturer of the system.
- D. Contractor shall remove any devices where construction occurs to prevent possible damage to the device. Removal of any devices which support user connection or other systems, shall be coordinated with the owner prior to removal and/or taking offline.

3.16 START-UP RESPONSIBILITY

- A. The Contractor shall initiate System operation. The Contractor shall provide competent Start-Up personnel on each consecutive working day until all Communications Systems are functional and ready to start the acceptance test phase. If the Contractor, in the Owner / Architect's judgment, is not demonstrating progress in solving any technical problems, the Contractor shall supply Manufacturer's factory technical representation and diagnostic equipment at no cost to the Owner, until resolution of those defined problems. Where appropriate, the Contractor shall bring the Systems on-line in their basic state (i.e., alarm reporting, facility code access control, etc.) It is the responsibility of the Owner to provide the specific database information that will be utilized for initial system programming.
- B. Properly ground each piece of electronic equipment prior to applying power. Properly ground all shielded wire shields to the appropriate earth ground at the hub end only, not at the remote or device end.
- C. Use a start-up sequence that incrementally brings each portion of the system on-line in a logical order that incorporates checking individual elements before proceeding to subsequent elements until the entire system is operational. The basic steps should include:
 - 1. Establish ground planes at the equipment rooms and hub end of the systems as specified in Division 26.
 - 2. Disconnect power, connect the first device, reconnect power, and verify operational correctness. Repeat until the entire system is verified and operational.

3.17 PREPARATION FOR ACCEPTANCE (SUBSTANTIAL COMPLETION)

- A. All systems, equipment, and devices shall be in full and proper adjustment and operation, and properly labeled and identified.
- B. All materials shall be neat, clean and unmarred, and parts securely attached.
- C. All extra material as specified shall be delivered and stored at the premises as directed.
- D. Test reports of each system and each system's components and As-Built Project Drawings shall be complete and available for inspection and delivery as directed by the Owner.

3.18 SYSTEM ACCEPTANCE REQUIREMENTS

- A. Before final acceptance or work, the Contractor shall perform and/or deliver each of the following in the order stated.
- B. The Contractor shall deliver three (3) composite "System Operations and Maintenance" manuals in three-ring binders, sized to hold the material below, plus 50% excess. Each manual shall contain in appropriately tabbed sections:
 - 1. A statement of Guarantee including date of termination and the name and phone number of the persons to be called in the event of equipment failure.
 - 2. A set of Operating procedures for the overall System that includes all required Owner activities, and that allows for the Owner operation of all attributes and facilities of the System.
 - 3. A section for each specific type of equipment containing the vendor manuals, instruction sheets, and any related literature that came in the original shipping container for that piece of equipment. Include all warranty cards.
- C. Testing:
 - 1. The Contractor shall perform all tests required by Division 26 and those submitted as part of this Section.
 - 2. The Contractor shall activate all devices for proper system operation, including supervisory and trouble circuit tests. Similarly, audible alarms will not be activated except on a one-time, coordinated basis, to check the actual sounding devices.
 - 3. A test report for each piece of equipment shall be prepared by the Contractor and submitted to the Owner. This report shall include a complete listing of every device, the date it was tested, by whom and the results. The final test reports shall indicate that every device tested successfully. Failure to completely test and document the tests will result in a delay of final testing and acceptance.
- D. As-Built Drawings:
 - 1. After completion of all the tests listed above, and prior to the final acceptance test, The Contractor shall submit the complete As-Built drawings as identified in PART 1 – PROJECT RECORD DRAWINGS.
 - 2. The final As-Built Drawings shall consist on one set of reproducible prints, two (2) sets of Point-to-Point Detail Drawings, Equipment Schedules, and the complete detailed technical data that was shipped by the manufacturer with all installed equipment.
- E. Final Acceptance Test: The Final Acceptance Test shall demonstrate the installed and activated System's performance and compliance with System Specifications. However, before this testing can begin the following must have received and reviewed by the Owner.
 - 1. System Operations and Maintenance Manuals
 - 2. System Test Reports
 - 3. As-Built Drawings

3.19 FINAL ACCEPTANCE

- A. The date of final acceptance shall be the date of owner occupancy, or the date all punch list items have been completed or final payment has been received. Refer to Division 1 for additional requirements
- B. When the Final System Acceptance Requirements described above including the Final Acceptance Test described above have been satisfactorily completed. The Owner / Architect shall issue a Letter of Completion to the Contractor indicating the

date of such completion. The Notice of Completion shall be recorded by the Contractor upon receipt of the Owner / Architect completion letter. This date of record shall be the start of the warranty period.

END OF SECTION

**SECTION 27 05 07 - COMMUNICATIONS SHOP DRAWINGS,
COORDINATION DRAWINGS & PRODUCT DATA**

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Prepare submittals as required by Division 01 and as outlined below.
- B. Submit product data shop drawings only for the following and for items specifically requested elsewhere in the Contract Drawings and Specifications. Architect / Engineer reserves the right to refuse shop drawings not requested for review and to imply that materials shall be provided as specified without exception.
- C. The term submittal, as used herein, refers to all:
 - 1. Shop Drawings
 - 2. Coordination Drawings
 - 3. Product data
- D. Submittals shall be prepared and produced for:
 - 1. Distribution as specified
 - 2. Inclusion in the Operating and Maintenance Manual, as specified, in the related section

1.2 SHOP DRAWINGS

- A. Present drawings in a clear and thorough manner. Identify details by reference to sheet and detail, schedule, or room numbers shown on Contract Drawings.
- B. Show all dimensions of each item of equipment on a single composite Shop Drawing. Do not submit a series of drawings of components.
- C. Identify field dimensions; show relation to adjacent or critical features or work or products.

1.3 COORDINATION DRAWINGS

- A. Present in a clear and thorough manner. Title each drawing with project name. Identify each element of drawings by reference to sheet number and detail, or room number of contract documents. Minimum drawing scale: 1/4"=1'-0".
- B. Prepare coordination drawings to coordinate installations for efficient use of available space, for proper sequence of installation and to resolve conflicts. Coordinate with work specified in other sections and other divisions of the specifications.
- C. For each room containing technology equipment and each rack with technology equipment, submit plan and elevation drawings. Show:
 - 1. Actual technology equipment and components to be furnished.
 - 2. NEC working space and NEC access to NEC working space.
 - 3. Relationship to other equipment and components and openings, doors and obstructions
 - 4. Rack location and dimensions
- D. Identify field dimensions. Show relation to adjacent or critical features of work or products.

- E. Verify location of communications station devices, telephone outlets and other work specified in this Division.
 - 1. Coordinate with drawing details, site conditions and millwork shop drawings prior to installation.
 - 2. Where required for clarification, submit shop drawings prior to rough-in and fabrication.
- F. Submit shop drawings in plan, elevation and sections, showing outlets and other devices in casework, cabinetwork and built-in furniture.

1.4 PRODUCT DATA

- A. All product options specified shall be indicated on the product data submittal. All options listed on the standard product printed data not clearly identified as not part of the product data submitted shall become part of the Contract and shall be provided.
- B. Mark each copy of standard printed data to identify pertinent products, referenced to specification section and article number.
- C. Show reference standards, performance characteristics and capacities; wiring and piping diagrams and controls; component parts; finishes; dimensions and required clearances.
- D. Modify manufacturer's standard schematic drawings and diagrams to supplement standard information and to provide information specifically applicable to the work. Delete information not applicable.
- E. Mark up a copy of the specifications for the product to indicate a) acknowledgement of the specification requirement (Comply), or b) acknowledgement that the particular specification requirement does not apply to this specific project (Not Applicable) or, c) acknowledgement that the specification requirement cannot be made or that a variance is being submitted for review to the Architect / Engineer / Owner (Does Not Comply, Explanation:)

1.5 MANUFACTURERS INSTRUCTIONS

- A. Submit Manufacturer's instructions for storage, preparation, assembly, installation, start-up and adjusting.

1.6 CONTRACTOR RESPONSIBILITIES

- A. Review submittals prior to transmittal.
- B. Determine and verify:
 - 1. Field measurements
 - 2. Field construction criteria
 - 3. Manufacturer's catalog numbers
 - 4. Conformance with requirements of Contract Documents
- C. Coordinate submittals with requirements of the work and of the Contract Documents.
- D. Notify the Architect / Engineer in writing at time of submission of any deviations in the submittals from requirements of the Contract Documents.
- E. Do not fabricate products, or begin work for which submittals are specified, until such submittals have been produced and bear contractor's stamp. Do not fabricate products or

begin work scheduled to have submittals reviewed until return of reviewed submittals with Architect / Engineer's acceptance.

- F. Contractor's responsibility for errors and omissions in submittals is not relieved whether Architect / Engineer reviews submittals or not.
- G. Contractor's responsibility for deviations in submittals from requirements of Contract Documents is not relieved whether Architect / Engineer reviews submittals or not, unless Architect / Engineer gives written acceptance of the specific deviations on reviewed documents.
- H. Submittals shall show sufficient data to indicate complete compliance with Contract Documents:
 - 1. Proper sizes and capacities
 - 2. That the item will fit in the available space in a manner that will allow proper service
 - 3. Construction methods, materials and finishes
- I. Schedule submissions at least 15 days before date reviewed submittals will be needed.

1.7 SUBMISSION REQUIREMENTS

- A. Make submittals promptly in accordance with approved schedule, and in such sequence as to cause no delay in the Project or in the work of any other Contractor.
- B. Number of submittals required:
 - 1. Shop Drawings and Coordination Drawings: Submit four opaque reproductions.
 - 2. Product Data: Submit the number of copies the contractor requires, plus those to be retained by the Architect / Engineer.
- C. Accompany submittals with transmittal letter, in duplicate, containing:
 - 1. Date
 - 2. Project title and number
 - 3. Contractor's name, address and telephone number
 - 4. The number of each Shop Drawing, Project Datum and Sample submitted
 - 5. Other pertinent data
- D. Submittals shall include:
 - 1. The date of submission
 - 2. The project title and number
 - 3. Contract Identification
 - 4. The names of:
 - a. Contractor
 - b. Subcontractor
 - c. Supplier
 - d. Manufacturer
 - 5. Identification of the product
 - 6. Field dimensions, clearly identified as such
 - 7. Relation to adjacent or critical features of the work or materials
 - 8. Applicable standards, such as ASTM or federal specifications numbers
 - 9. Identification of deviations from contract documents
 - 10. Suitable blank space for General Contractor and Architect / Engineer stamps
 - 11. Contractor's signed and dated Stamp of Approval
- E. Coordinate submittals into logical groupings to facilitate interrelation of the several items.

1. Finishes which involve Architect / Engineer selection of colors, textures or patterns
2. Associated items requiring correlation for efficient function or for installation

1.8 SUBMITTAL SPECIFICATION INFORMATION

- A. Every submittal document shall bear the following information as used in the project manual:
 1. The related specification section number
 2. The exact specification section title
- B. Submittals delivered to the Architect / Engineer without the specified information will not be processed. The Contractor shall bear the risk of all delays, as if no submittal had been delivered.

1.9 RESUBMISSION REQUIREMENTS

- A. Make resubmittals under procedures specified for initial submittals.
 1. Indicate that the document or sample is a resubmittal
 2. Identify changes made since previous submittals
- B. Indicate any changes which have been made other than those requested by the Architect / Engineer.

1.10 CONTRACTOR'S STAMP OF APPROVAL

- A. Contractor shall stamp and sign each document certifying to the review of products, field measurements and field construction criteria, and coordination of the information within the submittal with requirements of the work and of Contract Documents.
- B. Contractor's stamp of approval on any submittal shall constitute a representation to Owner and Architect / Engineer that Contractor has either determined and verified all quantities, dimensions, field construction criteria, materials, catalog numbers, and similar data or assumes full responsibility for doing so, and that Contractor has reviewed or coordinated each submittal with the requirements of the work and the Contract Documents.
- C. Do not deliver any submittals to the Architect / Engineer that do not bear the Contractor's stamp of approval and signature.
- D. Submittals delivered to the Architect / Engineer without Contractor's stamp of approval and signature will not be processed. The Contractor shall bear the risk of all delays, as if no submittal had been delivered.

1.11 ARCHITECT / ENGINEER REVIEW OF IDENTIFIED SUBMITTALS

- A. The Architect / Engineer will:
 1. Review identified submittals with reasonable promptness and in accordance with schedule. Specific equipment submittals that may be required to be expedited shall be submitted separately without other submittal items not requiring the same prompt attention.
 2. Affix stamp and initials or signature, and indicate requirements for resubmittal or approval of submittal
 3. Return submittals to Contractor for distribution or for resubmission

- B. Review of submittals will not extend to design data reflected in submittals that is peculiarly within the special expertise of the Contractor or any party dealing directly with the Contractor.
- C. Architect / Engineer's review is only for conformance with the design concept of the project and for compliance with the information given in the contract.
 - 1. The review shall not extend to means, methods, sequences, techniques or procedures of construction or to safety precautions or programs incident thereto.
 - 2. The review shall not extend to review of quantities, dimensions, weights or gauges, fabrication processes or coordination with the work of other trades.
- D. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.

1.12 SUBSTITUTIONS

- A. Do not make requests for substitution employing the procedures of this Section.
- B. The procedure for making a formal request for substitution is specified in Division 1.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 SHOP DRAWINGS AND PRODUCT DATA

- A. Submittals shall not be combined or bound together with any other material submittal.
- B. Submit individually bound shop drawings and product data for the following when specified or provided:
 - 1. Structural Cabling
 - 2. Communications System
 - 3. Sound Reinforcement System
 - 4. CATV System

3.2 COORDINATION DRAWINGS

- A. Submit coordination drawings as specified.

END OF SECTION

SECTION 27 05 09 - CONTRACT QUALITY CONTROL

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Contract quality control including workmanship, manufacturer's instructions, mock-ups and demonstrations.

1.2 QUALITY CONTROL PROGRAM

- A. Maintain quality control over supervision, subcontractors, suppliers, manufacturers, products, services, site conditions and workmanship to produce work in accordance with contract documents.

1.3 WORKMANSHIP

- A. Comply with industry standards except when more restrictive tolerances or specified requirements indicate more rigid standards or more precise workmanship.
- B. Perform work by persons qualified to produce workmanship of specified quality.
- C. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, and racking. Under no conditions shall material or equipment be suspended from structural bridging.
- D. Provide finishes to match approved samples; all exposed finishes shall be approved by the Architect / Engineer. Submit color samples as required.

1.4 MANUFACTURER'S INSTRUCTIONS

- A. Comply with instructions in full detail, including each step in sequence.
- B. Should instruction conflict with Contract Documents, request clarification from Architect / Engineer before proceeding.

1.5 MANUFACTURER'S CERTIFICATES

- A. When required in individual Specification Sections, submit manufacturer's certificate in duplicate, certifying that products meet or exceed specified requirements.

1.6 MANUFACTURER'S FIELD SERVICES

- A. When required in individual Specification Sections, manufacturer shall provide a manufacturer's qualified personnel to observe:
 - 1. Field conditions.
 - 2. Condition of installation.
 - 3. Quality of workmanship.
 - 4. Start-up of equipment.
 - 5. Testing and adjusting of equipment.
- B. Manufacturer's qualified personnel shall make written report of observations and recommendations to Architect/Engineer.

1.7 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 where possible.
- D. Perform tests and submit results as specified.

1.8 SCHEDULING OF MOCK-UPS

- A. Schedule demonstration and observation of mock-ups, in phases, with Architect / Engineer.
 - 1. Rough-in
 - 2. Finish with all appurtenances in place
 - 3. Demonstrations

PART 2 - PRODUCTS

2.1 REFERENCE APPLICABLE SPECIFICATION SECTIONS.

PART 3 - EXECUTION

3.1 ADJUSTMENTS AND MODIFICATIONS

- A. Contractor shall provide all adjustments and modifications as requested by the manufacturer's qualified personnel at no additional cost to Owner.

3.2 MOCK-UPS

- A. Mock-up a typical classroom, science lab of each type, and computer lab with all wiring devices, cover plates, rough-in boxes, conduits, etc. Provide all conductors from all wiring devices to above ceiling space to demonstrate conduit routing and conductor fill.

END OF SECTION

SECTION 270529 - PATHWAYS FOR AV SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Conduits
- B. Pull Boxes
- C. Conduit Fittings
- D. Floor Boxes

1.2 DESCRIPTION OF WORK

- A. Furnish and install all items listed in AV-001 required to support the AV systems cabling as indicated on the AV drawings, specified, or as otherwise required.

PART 2 - PRODUCTS

2.1 General

- A. Refer to AV Drawings for pathway type required for each cable run. Substitution of pathway type requires Consultant's approval. Pathways shown without cable fill are for temporary or future cable use.

2.2 CONDUITS

A. General

- 1. Provide Pull String in all conduits for AV system.
- 2. The sizes of conduits shall be as shown on the drawings, minimum size is 0.75". All conduits shall be reamed and furnished with insulation and/or grounded bushings as required.

B. Flexible Steel Conduit

- 1. Flexible steel conduits are not acceptable for AV systems installations

C. Electrical Metallic Tubing (EMT)

- 1. EMT shall be zinc galvanized both inside and out with a minimum thickness of .0008". It shall be round with uniform wall thickness and continuously welded seams. EMT shall be furnished in ten-foot standard lengths.

D. PVC Conduit

- 1. PVC conduit shall be rigid non-metallic Schedule 40 heavy wall.
- 2. Use of PVC shall be limited to underground conduits only.

- E. Conduits carrying fiber cables shall have large labels indicating "Fiber Optic Cable." These labels should be placed every 10 feet where exposed.
- F. Buried conduits must have yellow "Caution Fiber Optic" tape laid 12 inches above duct bank.

2.3 PULL BOXES

- A. Pull boxes shall be constructed of code gauge steel, etched, primed and shall have rust resistant ANSI 61 gray finish and be NEMA 1 construction with screw covers unless noted otherwise. For conduits 1-1/4" and larger terminating in a pull box, the minimum length of pull box shall be 8 times the diameter of the largest conduit terminating in the pull box. Splice boxes shall be sized as per EIA/TIA-569A Table 5.2-3.
- B. Location and sizes of pull boxes and splice boxes shall meet the approval of the Architect and Consultant. Condulete type fittings (e.g. LB's, etc.) shall not be used in lieu of pull boxes or bends.
- C. Exposed pull boxes in public areas shall be provided with tamperproof screws.
- D. Boxes shall be free from unused openings, including knockouts.
- E. Pull boxes larger than 12" x 12" for which a custom panel has not been specified, shall have hinged covers.
- F. Gang, 4" square and 4-11/16" square boxes must be installed using open center brackets
- G. Pull boxes for indoor wet or damp locations shall be NEMA 3R Rated with stainless steel screws.
- H. Pull boxes for outdoor locations shall be NEMA 4X Rated stainless steel continuous hinges, door clamps and a hasp.
- I. Provide junction box, pull box, and hand-hole assemblies sized as required by the NEC. Pull boxes/hand-holes shall be located using the following table:
 - 1. Runs with total of all bends <90 degrees – 600ft.
 - 2. Runs with total of all bends >=90 degrees and <180 degrees – 400ft.
 - 3. Runs with total of all bends >= 180 degrees and <270 degrees – 200ft.
 - 4. Runs with total of all bends >= 270 degrees are not allowed.

2.4 CONDUIT FITTINGS

- A. All rigid, IMC and EMT fittings shall be galvanized malleable iron or steel. Connectors and couplings shall be threaded, setscrew, compression type, and concrete-tight.
- B. Conduit bodies shall be malleable iron, threaded type. Provide neoprene cover gaskets for conduit body covers exposed to the weather.
- C. Expansion fittings shall be O-Z/Gedney Type "AX" for rigid metal conduit and Type "TX" for electrical metallic tubing. For intermediate metal conduit applications, a 15-inch minimum length of rigid metal conduit shall be used with a Type "AX" expansion fitting. Provide O-Z/Gedney Type "BJ" bonding jumpers at all expansion fittings.

- D. Rigid and IMC conduit bushings shall be of the insulated type with phenolic thermosetting insulation molded to a hot dipped galvanized malleable iron body of the threaded type.
- E. EMT fittings shall be of the insulated throat type. Fittings larger than 2-1/2 inches shall have threaded bushings installed.
- F. PVC conduit fittings shall be slip joint type.
- G. All conduit sleeves will be fitted with "spillways" to maintain the bend radius of cables passing through the sleeve.

2.5 FLOOR BOXES

- A. Refer to AV drawings for manufacturer, model, quantity, and location information.
- B. Contractor to provide all parts and accessories required for a working floor box system including those required based on specific installation conditions unless otherwise noted.
- C. Boxes to have a voltage divider to allow for power receptacles and low-voltage AV connections to reside within the same box. Conduits for high and low voltages must enter box on appropriate side of voltage divider to maintain separation. High and low-voltage wires may not cross within the box.
- D. On-grade boxes to be cast-iron, and above grade, in-slab boxes to be steel.
- E. Boxes to be fully adjustable, before and after the concrete pour.
- F. Boxes shall have applicable approvals from a Nationally Recognized Testing Laboratory and meet all applicable local codes.
- G. Floor Boxes on elevated floors must maintain proper fire rating of slab.
- H. Provide equipment ground conductor as required by local code.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General
 - 1. Whenever possible, cable and raceway routing paths shall follow the logical structure of the building (e.g. follow hallways, aisles and corridors). Route all AV cables and raceways parallel to or perpendicular to the building structure. No diagonal runs will be permitted unless noted otherwise or pre-approved by the Architect and Consultant. Corridor crossovers shall be kept to a minimum.
 - 2. Coordinate layout of conduits including specific routing and mounting elevations with building structure and work of other trades.
 - 3. Provide a pull string in all raceways, cable trays and conduits.
 - 4. Transitions between cable trays and conduit, etc. shall not exceed 10" horizontally, 24" vertically. Provide "drop-out" supports spillways, and radius controls for changes in elevation as required.

5. All power devices and power sources emit a given amount of radio frequency interference (RFI) and/or electro-magnetic interference (EMI). To reduce or eliminate the field effects of RFI/EMI on the signals residing on a given cable, runs shall be kept at the maximum possible distance from such sources. Running cables through the center of the building can reduce the external interference effects of RFI/EMI in the cable tray. Open wiring and non-metallic raceway shall be routed a minimum of twelve (12") inches away from fluorescent fixtures. Special attention shall be given to the routing of such pathways away from lighting ballasts and high intensity discharge devices. Reference AV-001 for the required separation distances of signals of different types.

B. Conduits

1. Provide continuous conduits across open or inaccessible ceiling areas.
2. Changes from home run conduits to stub up must be approved by The Consultant.
3. Provide conduits from cable trays to accessible ceilings as required.
4. Conduits attached to cable trays shall be secured with approved conduit clamps.
5. Conduit buried in concrete slab pours shall be full weight rigid galvanized steel or Schedule 40 PVC. All elbows, stub ups and conduit above ground shall be rigid galvanized steel. All joints and terminations for PVC shall be made according to manufacturer's recommendations to ensure all joints are watertight.
6. Conduit buried in or beneath building slabs or exterior below grade shall be full weight rigid galvanized steel or Schedule 40 PVC. The conduit shall be encased in 3" concrete envelope or as called for on the Plan Drawings. All elbows and stub ups shall be rigid galvanized steel. All joints and terminations for PVC shall be made according to manufacturer's recommendations to ensure all joints are watertight.
7. Conduits and cables entering from outside the building shall be sealed water and moisture tight. Seal between conduit and sleeves, conduits and core drilled holes and around conductors inside conduits. Provide cast iron pipe or Schedule 40 galvanized steel conduit sleeves in exterior walls below grade, with intermediate wall stop and anchor collar set in place before concrete pouring. Sleeve shall be a part of the sealing assembly. When the wall opening is core drilled, the wall sleeve may be omitted. A mechanically compressed rubber sealing assembly shall be placed in the annular space between conduit and the sleeve or the core drilling.
8. Conduits stubbed out into accessible ceiling to be located no more than 2'-6" above finished ceiling.
9. All conduit stub-outs and junction boxes in accessible ceilings to remain accessible by ladders from the finished floor below.
10. Layout the conduit system to avoid crossing building expansion joints. Where crossings are necessary, use expansion joints.

C. Boxes

1. Wall or ceiling boxes must be mounted flush with finished surface.
2. Final mounting height of all boxes on finished surfaces to be coordinated with Architect for alignment with adjacent boxes.
3. In stud walls, boxes on opposite sides of the wall must be separated by a minimum of 1 stud cavity.
4. In CMU or concrete walls, boxes on opposite sides of the wall must be separated by a minimum of 16".
5. Pull boxes shall be placed in straight sections of conduit runs and may not be used in lieu of a bend without approval of the Consultant. Pull boxes and/or splice boxes shall be installed in readily accessible locations. Where boxes are installed above suspended ceilings, they shall be located immediately above the

suspended ceiling or the ceiling shall have a suitably marked and hinged panel to facilitate direct access to the pull box.

6. Boxes in accessible ceiling to be located no more than 2'-6" above finished ceiling.
7. All boxes mounted in accessible drop tile ceilings to remain accessible by ladders from the finished floor below.

D. Fire Stopping

1. Where pathways pierce walls, floors and/or ceilings, restore fire rating and smoke stoppage integrity as required by code.

E. Excavation:

1. It is the responsibility of the Contractor to obtain all permits and utility marking. Bids shall include landscaping restoration costs.

END OF SECTION

SECTION 27 10 00 - STRUCTURED CABLING SYSTEM (SCS)

PART 1 - GENERAL

1.1 RELATED WORK

The following, in their entirety and as applicable, shall apply to this section. Including any associated drawings.

- A. Conditions of the Contract
- B. Division 1
- C. Division 26
- D. Division 27
- E. Division 28

1.2 DESCRIPTION

A. Summary of Work:

1. Reference Attachment 'A' of this specification for supplemental scope as it relates to the project and the Owner standards.
2. Provide a complete and tested Structured Cabling System (SCS) for the interconnections of the Local Area Network (LAN). The SCS shall include fully terminated unshielded twisted pair cables, fiber optic cabling, raceways, conduit, back boxes, copper/fiber optic termination components, station mounting hardware, fiber optic enclosures, patch panels, copper/fiber optic patch cables, relay cabinets/cabinets, and other incidental and miscellaneous premises wiring system hardware as required for a complete, tested, and usable system that is in compliance with the latest NEC, ANSI/EIA/TIA, BICSI, and Authorities Having Jurisdiction codes and standards. The installation shall comply with all applicable requirements, design guidelines, and standards in effect at the job site and as indicated in the Drawings and Specifications.
3. An IDF will be required when the distance between outlet terminations and MDF/IDF exceeds 280', including service loops. IDF's shall be selected and organized to be minimum in number while still reaching all locations to be wired.
4. 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 costliest scenario and obtain clarification during the project.
5. These documents are conceptual in nature. It shall be the responsibility of the approved installer to furnish a complete and functional system, including the items shown on the drawings, in the specifications, and items not designated in either. The installer's shop drawings and product data submittals shall represent a complete system and documents accepted do not relieve the installer from being required to provide any materials, equipment, or labor to furnish a complete and functional system as recognized by the Project's Technology Consultant and the Owner.

1.3 QUALITY ASSURANCE

A. Acceptable manufacturers:

1. The equipment/products described herein and furnished per these specifications shall be the product of one manufacturer or must be able to obtain the full warranty of the combined solution. All references to model numbers and other detailed descriptive data is intended to establish standards of design performance, and quality, as required. The contractor shall not deviate from the part numbers listed.

Any deviation from specified part numbers will result in the removal of non-specified materials and reinstallation of approved materials at no cost to the project.

2. The approved manufacturers shall provide a complete End-to-End solution with the maximum product and performance warranty offered by the specified manufacturer.
3. Only products listed in Attachment 'B' or approved in compliance with the project manual's approval requirements will be accepted.

B. Installer Qualifications:

1. The Data Cable System Installer shall be licensed and shall meet all applicable regulations of the State 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) large-scale projects and contact names confirming successful Structure Cabling System installations.
2. The SCS Installer shall be a Certified, local area, integrator of the manufacturer's product and must be able to provide the manufacturer's maximum available warranty for the solution 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. Low Voltage Meeting Requirements:

1. The successful Contractor shall attend a mandatory pre-construction meeting with the project's consultant individuals deemed necessary by the Owner's representative prior to the start of the work. No SCS work shall begin prior to this meeting.
2. The successful contractor shall attend a mandatory bi-weekly meeting to discuss the project progress to help aid coordination with the Owner and Other contractors.
3. Prior to the installation of any items required for this scope of work the contractor must provide a purchase order with a detailed material list for all materials to be installed. The purchase order is not required to show cost, but part numbers must be provided. The purchase order will be reviewed during one of the regularly scheduled low voltage meetings.

D. Acceptance: 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 certified installing contractor of product and hold current certification. Contractor shall provide the specified manufacturer's maximum end-to-end performance warranty 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 cable links have been tested bi-directionally (end to end) using a Level IIIe or better tester,

per TSB-67, and that all test results conform to the most current ANSI/TIA-568.2-D.

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 ANSI/TIA/EIA-568.3-D. Quality and workmanship evaluation shall be solely by the Owner/Designer and designated representatives.

1.4 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. National Electrical Code, current version
- B. Other References:
 1. ANSI/TIA-568-C.0 – Generic Communications Cabling for Customer Premises...
 2. ANSI/TIA-568-C.1 – Commercial Building Communications Cabling Standard Part 1: General Requirements.
 3. ANSI/TIA 568-C.2 – Balanced Twisted-Pair Telecommunications Cabling and Components Standards
 4. ANSI/TIA 568-C.3 – Optical Fiber Cabling Components Standard
 5. ANSI/TIA-568-C.4, Coaxial Cabling Component Standard
 6. ANSI/TIA-569-C – Commercial Building Standard for Telecommunications Pathways and Spaces.
 7. ANSI/TIA-492.AAAC-B – Detail Specification for 850-nm Laser-Optimized, 50-um Core Diameter/125-um Cladding Diameter Class 1a Graded-index Multimode Optical Fibers (OM3/OM4). Current Edition
 8. ANSI/ICEA S-83-596, Fiber Optic Premises Distribution Cable.
 9. ANSI/TIA/EIA-598, Color Coding of Optical Fiber Cables
 10. ANSI/ICEA S-87-640, Fiber Optic Outside Plant Distribution Cable.
 11. ANSI/TIA/EIA-758: Customer-Owned Outside Plant Telecommunications Cabling Standard.
 12. ANSI/TIA/EIA-526-7, Optical Power Loss Measurements of Installed Single mode Fiber Plant: OFSTP-7.
 13. ANSI/TIA/EIA-526-14-A, Optical Power Loss Measurements of Installed Multimode Fiber Plant: OFSTP-14A
 14. ANSI/TIA/EIA-TSB-125, Guidelines for Maintaining Optical Fiber Polarity Through Reverse-Pair Positioning
 15. ANSI/TIA/EIA-TSB-140, Additional Guidelines for Field Testing Length, Loss, and Polarity of Optical Fiber Cabling Systems.
 16. ANSI/TIA-606-B – Administration Standard for the Commercial Telecommunications Infrastructure
 17. TIA/EIA-607-B - 2011 - Commercial Building Grounding and Bonding Requirements for Telecommunications
 18. Institute of Electrical and Electronic Engineers (IEEE 802.xLAN)
 19. TIA/EIA 942 Data Center Standards
 20. Current BICSI Telecommunications Distribution Methods Manual
 21. NFPA 70 – National Electrical Code (NEC).
 22. BICSI – TDMM, Building Industries Consulting Services International, Telecommunications Distribution Methods Manual (TDMM).
- 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.

1.5 ABBREVIATIONS

- A. The following abbreviations are used in this document:
- | | |
|------|---|
| IDF | Intermediate Distribution Frame |
| MDF | Main Distribution Frame |
| UTP | Unshielded Twisted Pair |
| SCS | Structured Cabling System |
| RCDD | Registered Communications Distribution Designer |

1.6 SUBMITTALS

- A. Project Initiation: Within fourteen (14) days of Notice to Proceed, the data network 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 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
 3. 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.
 4. Testing: Proposed Contractor UTP cable test result forms, fiber optic cable test result forms and a list of instrumentation to be used for systems testing.
 5. 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 approved by the Owner.
 6. Each Submittal must have a detailed parts list with quantities.
 7. Certifications: The contractor shall submit all certifications for approved products 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.
 - a. 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 project.
 - b. Certifications must be obtained by the SCS installer's office that is located within 75 miles of the project and shall be a company certification, not an individual certification.
 - c. Certifications 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.
 - d. 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: Submit the following items, for Owner review and approval, within twenty-eight (28) days of notice to proceed:
1. 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.
 2. 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:
 - 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
 - e. 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)
 - f. Conduit routing, size, quantity, and stub-up locations for all floor mounted outlets.
 3. 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 approved by the Owner.
 4. All subcontractors shall provide submittals to general contractor for normal distribution to Architects, Engineers and the Owner's project managers.
- C. At Substantial Completion: Provide drawings, to the Owner, to reflect installed cabling with correct labeling and cable routing.
- D. Close-out Procedures: Two (2) copies of the following documents shall be delivered to the building owner's representative at the time of system acceptance. Close out technology documents shall be separated from all other trade's documents. The close out finals shall include:
1. 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.
 2. Provide complete test reports for all cabling and devices that comprise system as outlined in this document.
 3. Include the Name, address and telephone of the authorized factory representative with a 24-hour emergency service number.
 4. The manual shall also include Manufacturer's data sheets and installation manuals/instructions for all equipment installed a list of recommended spare parts.
 5. Generic or typical owner's instruction and operation manual shall not be acceptable to fulfill this requirement.
 6. 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.

7. As-built Drawings shall include cable pathways, camera locations with correct labeling and MDF/IDF locations. A copy of the As-Built drawings reflecting the final locations of all cabling shall be given to the designated Owner's representative. The as-built drawings shall be prepared using AutoCAD 2012 or later. Provide the Owner with electronic versions of the as-builts on CD media.
8. All drawings must reflect final graphic numbering, 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.
9. A copy of the manufacturer's warranty on the installed system.
10. Any keys to cabinets and/or equipment and special maintenance tools required to repair, maintain, or service the system.
11. 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)
12. 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.
13. One (1) 30" x 42" laminated floor plan sheets illustrating technology drops and cable designation with final graphic numbering. Contractor shall provide one complete floor plan sheet for each telecommunications room (MDF or IDF)

PART 2 - PRODUCTS

2.1 GENERAL

- A. Reference Attachment 'B' to this specification, which contains the minimum materials list for this specific project.
- B. 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.
- C. 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.
- D. 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.
- E. 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 |

STRUCTURED CABLING SYSTEM
271000-6

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- F. 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.
- G. Cable Lubricants:
 - 1. Lubricants specifically designed for installing communications cable may be used to reduce pulling tension as necessary when pulling cable into conduit.
 - 2. Approved Products
 - a. Twisted-pair cable: Dyna-Blue
 - b. American Polywater
- H. Fire Wall Sealant:
 - 1. Any penetration through firewalls (including those in sleeves) will be resealed with an Underwriter Laboratories (UL) approved sealant.
 - 2. Approved Products
 - a. 3M or
 - b. Pre-approved equal

2.2 DATA CLOSET (MDF/IDF) HARDWARE

- A. Equipment Cabinets/Cabinets: Provide and install equipment cabinets and/or cabinets in locations indicated on the attached drawings for the following areas.
 - 1. For all MDF/IDF locations: Contractor shall provide and install a new floor mounted cabinet/rack system or a wall mounted cabinet where indicated on plans. Refer to floor plan and enlarged MDF/IDF room layouts for number of cabinets/racks to provide at each location. If an enlarged detail is not available, the contractor shall provide the required number of racks to accommodate 100% of all termination components and an equal amount of owner equipment; as well as (1) spare rack. If an MDF/IDF is located in shared space, the contractor shall provide a floor supported, wall mounted cabinet system with all required doors and side panels to secure the equipment and termination components.
- B. Distribution Cabinet/Cabinet Grounding: All Cabinets 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.
- C. Fiber Optic Patch Panels:
 - 1. The enclosures used shall provide termination panels for the specified type of connectors and be of sufficient size and capacity to terminate 110% of the fiber count of the inside of outside fiber optic cables. Patch panels must be 19" cabinet mountable. Provide all termination accessories, fiber patch cords, enclosures and test for a complete fiber optic distribution system.
 - 2. Provide closet connector housing panels, size for 110% of total fiber count to be terminated.
 - 3. ALL fiber strands must be terminated in fiber housing.
- D. Patch Panels:
 - 1. All patch cables shall be modular type patch panels to allow individual jacks to be inserted. All patch panels shall be fully populated with Jacks. Provide dust caps for all unused jacks. Furnish units that adhere to the performance requirements TIA/EIA-568A standards.

2. Provide cable support bars at the back of all patch panels to provide additional support at rear of panels. Provide one (1) support bar for each row of 24-ports. Support bars will not be required if the closet design consist of rear horizontal cable management above and below each patch panel.
- E. Rack Electrical:
1. A power strip shall be installed vertical at the back of each data relay rack.
 2. Project electrical contractor to provide and install one electrical receptacle for each UPS installed on the entire project. Coordinate receptacle type and location with the installed product requirements and the technology consultant prior to installation.
- F. Cable Management Panels:
1. Provide cable management panels as required for vertical cable management on ends and in between all racks on entire project.
 2. Provide Velcro straps for cable dressing in MDF/IDF rooms.
- G. MDF/IDF Patch Cables:
1. Cabling Contractor shall provide owner with one (1) 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. 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. All patch cables shall be factory terminated. NO EXCEPTIONS.

2.3 CABLE ROUTING/PATHWAY

- A. Cable Tray:
1. Metal cable tray shall be provided to affix to the top of all floor mount cabinets. Cable tray shall be used to brace cabinets to walls and to route cable from walls to cabinets in communication closets.
 2. Contractor to provide and install all applicable installation accessories.
- B. Cable Support System:
1. All low voltage cabling shall be installed and supported using an approved cable support system installed at 48" intervals unless installed in conduit. Do not exceed manufacturer's recommendation for the quantity of cables supported in an individual support.
 2. Cable supports shall not connect to any ceiling grid wire or on any support attached to the ceiling grid.
 3. Cable supports shall not exceed a serviceable height of more than 5', but no closer than 2', above the finished ceiling.
 4. Cable supports can be attached to vertical walls or the building's structure.
 5. If attached to the building's structure, 3/8" threaded rod shall be utilized to extend down within the serviceable heights mentioned above. Grid wire hangers will not be accepted.
- C. All cable bundles shall be grouped together using plenum rated Velcro for the entire run above and below the ceilings.
- D. Conduit Bushings shall be installed prior to the installation of any cable. If cable is found to be installed without the bushing the cable will have to be removed and re-installed. No cut bushings will be accepted. If cable damage occurs during any portion of the installation, the cable will be removed and replaced at no cost to the project. This item will be strictly enforced and adhered too.

- E. The projects electrical contractor shall provide and install all metallic conduit and backboxes indicated to be installed on the drawings. It is the SCS installer's responsibility to coordinate all conduit requirements with the electrical contractor to ensure that all conduit sizes and locations are correctly installed. If box locations and conduit sizes are found to vary from the project documents after installation the SCS installer will bare all financial responsibility to ensure these items are installed correctly. The RCDD for the SCS will be responsible for ensuring conduit sizes are sufficient for cable count while maintaining a 40% fill ratio. If there is not electrical contractor on the project, the SCS Installer shall bear responsibility for the provision and installation of all required raceways.

2.4 STATION WIRING

- A. Wire: The data and voice wire provided for all outlets shall be four-pair, solid copper conductor, meeting the intent and quality level of the TIA/EIA-568 Commercial Building Wiring Standard.
- B. Testing: The 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.
- 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. All cable shall be routed to the center of the room in which it is serving and then route to the outlet location that it is intended for. Provide a 5' service loop in the center of the room and 5' service loop at each workstation outlet properly supported above ceiling. All workstation service loops shall be made in figure eight configurations, no exceptions.
- E. Provide minimum of 10' service loop at all headend locations properly supported above ceiling.
- F. Provide indoor/outdoor, plenum rated category cable at any outdoor data outlet or data outlets served by cabling that travels through subsurface conduit. This applies to station or horizontal cable runs only.

2.5 STATION HARDWARE

- A. Information Outlet / Jack Modules:
 - 1. Shall be high quality 8p/8c modular jacks with circuit board construction and IDC style or 110-style wire, T568B terminations. Jacks shall meet EIA/TIA TSB40 recommendations for connecting hardware
 - 2. Shall be standard 8-position, RJ-45 Style, FCC compliant
 - 3. Shall be designed for 4-pair, 100 Ohm balanced UTP Cable
 - 4. Shall terminate 26-22 AWG solid or stranded conductors
 - 5. Shall accept FCC compliant 6 position plugs.
 - 6. Shall have attached wiring instruction labels to permit either T568A or T568B wiring configurations.
 - 8. Shall meet or exceed transmission requirements for connecting hardware, as specified in ANSI/TIA/EIA-568-C2, Transmission Performance Specifications for 4-Pair 100 Ohm.
 - 9. Shall be UL Listed and CSA certified.
 - 10. Each jack shall have category rating identified on the front face.
- B. Faceplates:

1. Standard faceplates shall be a minimum of 4-port.
 2. Wall mounted telephone faceplates shall be 1-port.
 3. All faceplates shall be single gang.
 4. All blank inserts color shall be coordinated prior to procurement.
- C. Outlet Patch Cables: Cabling Contractor shall provide owner with 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.
1. Cabling Contractor shall provide owner with 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.
 2. Patch cords shall be stranded copper, matching the category of the installed cable.
 3. All patch cables shall be factory terminated. No exceptions

2.6 FIBER OPTIC PRODUCTS

- A. Multimode: 50/125um, OM4+, multimode fibers, each with a color-coded PVC tight buffer shall have a maximum attenuation of 3.5 dB/km at 850 nm and 1.5 dB/km at 1300 nm. Minimum bandwidth shall be 2000 MHz/km at 850 nm and 500 MHz/km at 1300 nm.
- B. Singlemode: Single mode fibers, each with a color-coded PVC tight buffer shall have a maximum attenuation of 1.0 dB/km at 1310 nm and 1.0 dB/km at 1550 nm.

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. 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 manufacturers 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 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.
- H. Conduit and Back Boxes:
 - 1. The Contractor shall ensure that the appropriate back boxes and conduits, for the project, are provided as required.
 - 2. One (1) 1" conduit will be required each outlet that serves one to a maximum six (6) category 6 or a maximum of four (4) category 6A cables. Provide additional conduit for cable counts that exceed this number.
 - 3. One (1) double gang deep box will be required for each technology outlet. All boxes except Presentation outlets will be required to have a single gang reducer ring.

3.2 EQUIPMENT CABINET CONFIGURATION

- A. Equipment Cabinets: 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. Vertical cable management panels shall be installed on each side of the cabinet.
- 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. Cable bundles shall not exceed more than 48 cables to patch panel.
- F. Hardware: Provide cabinet and jack panel hardware as required for all data station wiring.

3.3 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 UTP cable at either the wiring

- closet or the workstation termination locations.
3. All cable shall be routed to the center of the room in which it serves before routing to the outlet location and a 5' service loop shall be provide. An addition 5' service loop shall be provided above ceiling at the outlet location. All service loops shall be figure 8 loops.
- B. Exposed Cable:
1. All cabling shall be installed inside walls or ceiling spaces whenever possible. Exposed cables and/or cables routing through mechanical rooms, electrical rooms, or restrooms shall be installed inside conduits, unless noted otherwise on the project drawings.
 2. Additional exposed cable runs will require Owner approval and will only be allowed when no other options exist.
 3. All cable routing through conduits and sleeves shall maintain a 40% maximum conduit fill ratio.
- 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, or Panduit Corp. J-MOD modular cable support with Velcro cable wrap at each location. Cable supports 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. Contractor shall adhere to the manufacturer's suggested fill ratio for each size cable support installed. No support shall have more than 48 cables.
 2. Attaching cable to pipes or other mechanical items is not permitted. 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 routed down the corridors; parallel or perpendicular to building structure. Multiple cables to be bundled together at and between each cable support installed.
 3. Contractor shall be responsible for coordinating with other trades on the project so that the installed cable pathway does not interfere with the installation of other systems to insure that mechanical ducts, pipes, conduits, or any other above ceiling systems are not putting unnecessary stress on any portion of the install SCS.
 4. All (48) cable bundles shall be routed directly to the MDF or IDF that serves the area. All bundles shall remain separated for the length of the cable run.
 - a. Provide data outlet for irrigation controllers. Coordinate location with landscape consultant.
 - b. Provide data outlet for time clock appliance in main custodian office.
 - c. Provide OSP or flooded/gel filled cat6 cable at any outdoor data outlet or data outlets served by cabling that travels through subsurface conduit. This applies to station or horizontal cable runs only.

3.4 STATION HARDWARE

- A. Flush Mount Jacks shall be mounted in a faceplate with back box.

- B. Placement:
 - 1. 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.
 - 2. Outlets shall be installed within 3'-0" of power outlets
- 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)

3.5 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:
 - 1. 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.
 - 2. Acceptance shall be subject to completion of all work, successful post-installation testing which yields 100% PASS rating, and submittal and approval of full documentation as described above. Tests with the "*" PASS" (asterisk) will not be acceptable. These circuits must be repaired to meet "PASS".
- E. 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.
- F. 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. Products shall be tested for compliance with ANSI/TIA/EIA 568A and ISO/IES 11801. 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 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.

- G. Fiber Optic Cable Testing:
1. Testing device for fiber optic cables shall be a high quality OTDR (Optical Time-Domain Reflectometer) equipped with a printer. The printed data shall show, in addition to any summary information, the complete test t0.and all relevant scale settings. The OTDR must have the capability to take measurements from bare fiber strands as well as SC connector terminations.
 2. All fiber optic cable shall be tested on the reel before installation to ensure that it meets the specifications outlined herein.
 3. After installation the Contractor shall test each fiber strand in accordance the EIA 455-171 Method D procedures (bi-directional testing) at both 850nm and 1300nm for multimode or 1310nm and 1550nm for single mode. A form shall be completed for each cable showing data recorded for each strand including length, total segment (end-to-end) loss (dB) and connector losses (dB) at each end. In addition, the printed data strip for each strand shall be attached to the form. Patch cables shall also be tested.
 4. Acceptable fiber optic connector loss shall not exceed .75dB per mated pair. The Contractor is responsible for obtaining minimum loss in fiber connections and polishing per manufacturer specifications.
 5. Singlemode fibers shall have a maximum attenuation of 1.0 dB/km at 1310 nm and 1.0 dB/km at 1550 nm.
 6. Multimode: 50/125um micron multimode fibers shall have a maximum attenuation of 3.5 dB/km at 850 nm and 1.5 dB/km at 1300 nm. Minimum bandwidth shall be 2000 MHz/km at 850 nm and 500 MHz/km at 1300 nm.

3.6 INSPECTION

- A. Conformance to the installation practices covered above is 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 2012 or greater.
 - d. Documentation of outlet, cable and cabinet 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.

ATTACHMENT 'A'

PROJECT SPECIFIC SCOPE OF WORK AND INSTRUCTIONS

PART 1 – SUMMARY OF WORK

1.1 DESCRIPTION OF WORK

- A. This project consists of the provision and installation of a Structured Cabling System (SCS) as required to support network connectivity to workstations, telephones, video surveillance, access control, building automation, electrical lighting, and any other system requiring network connectivity. This project is a new, _____ Square Foot, _____ for _____. The project site will be located at _____ Rd., City of _____, State, ZIP Code.
- B. The work includes provision and installation of a complete Cabling System (SCS) in compliance with these specifications and associated drawings, pre-proposal addenda, change orders, change directives and any other documents issued both pre-proposal and during the project.
- C. The SCS Installer shall comply with all conditions of the contract and "Division 1 – General Requirements" as they apply to the SCS Scope of Work. It shall be the responsibility of the SCS Contractor to make themselves familiar with all documents.
- D. It should not be assumed that any portions of a complete and functional system are to be *furnished and/or provided by anyone, other than the SCS installer, unless specifically stated otherwise.*
- E. Division of responsibilities:
OFOI = OWNER FURNISHED AND OWNER INSTALLED
CFCI = CONTRACTOR FURNISHED AND CONTRACTOR INSTALLED
 - 1. CATEGORY 6A CABLING – OFOI
 - 2. MDF/IDF NETWORK EQUIPMENT – OFOI
 - 3. VOIP TELEPHONES – OFOI
 - 4. WIRELESS ACCESS POINTS – OFOI
 - 5. UNINTERRUPTIBLE POWER SUPPLIES – OFOI
 - 6. RACEWAY: CONDUIT, BACK BOXES, SLEEVES, ETC – CFCI

1.2 STRUCTURED CABLING SYSTEM – ADDITIONAL INSTRUCTIONS

- A. Base Proposal:
 - 1. The SCS Installer shall provide and install a Commscope/Systimax End-to-End Structured Cabling System as per these specifications and associated drawings. The Base bid SCS shall consist of:
 - a. Category 6A cable and connectivity to each Video Surveillance Camera, Voice/Data Outlet, Access Controlled Door, and any other locations requiring Local Area Network Connectivity.
 - b. Category 6A cable and connectivity to each Wireless Access Points.
 - c. Each connectivity solution be a complete Channel Solution; consisting of jacks, patch panel, and patch cables.
 - d. Each channel solution shall be color coded to the system in which it serves.
 - 2. The products specified in Attachment 'B' are intended to establish quality, functionality, color, and standards. The following shall be considered

preapproved equivalent for each specific portion of the SCS.

- a. Category 6A copper cable
 - 1) Commscope/Systimax
- b. Category 6A copper cabling, termination components, and patch cables
 - 1) Commscope/Systimax
- c. Fiber Optic Cabling and Components:
 - 1) Commscope
- d. Metals (racks, cable managers, and cable tray):
 - 1) Commscope
- e. Manufacturer approval request must be submitted in compliance with the Division 1 instructions and must be received no less than ten (10) business days prior to the posted proposal submission date. No substitutions will be allowed if not submitted per these instructions and approved via official pre-bid addendum.

1.3 COPPER PATCH PANELS

- A. The SCS Installer shall provide and install patch panels as per the instructions below.
 1. 24-port patch panels shall only be used for copper tie cables and demarcation extensions.
 2. Provide dedicated, 48-port patch panels for each of the following system (reference color code chart for designated insert and patch panel color coding per system):
 - a. LAN and IP Telephones
 - b. Wireless Access Points
 - c. IP Intercom
 - d. Video Surveillance Cameras

1.4 COPPER AND FIBER OPTIC PATCH CABLE LENGTHS

- A. The SCS Installer shall provide copper and fiber optic patch cables as per the instructions below. All patch cables shall be factory terminated and warranted for the copper and fiber solutions specified.
 1. MDF/IDF Copper Patch Cables:
 - a. Patch cables shall be category 6A
 - b. Provide one patch cable for each port on the entire project
 - c. Patch cables to be installed by network equipment installer/programmer
 - d. Patch cable lengths
 - 1) 95% shall be 5'
 - 2) 5% shall be 7'
 2. Work Area Outlet Copper Patch Cables:
 - a. Patch cables shall be category 6A
 - b. Provide one patch cable for each port on the entire project
 - c. Patch cables to be installed by the owner.
 - d. Patch cable lengths
 - 1) 90% shall be 10'
 - 2) 10% shall be 15'
 3. Wireless Access Point Copper Patch Cables:
 - a. Patch cables shall be category 6A
 - b. Provide one patch cable for each port on the entire project
 - c. Patch cables to be installed by wireless system installer.
 - d. Patch cable lengths
 - 1) Interior Ceiling Access Points: 100% shall be 1.5'

- 2) Interior Wall Mounted Access Points: 100% 1'
- 3) Exterior Access Points: 100% shall be 15'

- 4. Video Surveillance Camera Copper Patch Cables:
 - a. Patch cables shall be category 6A
 - b. Provide one patch cable for each port on the entire project
 - c. Patch cables to be installed by the Video Surveillance System Installer.
 - d. Patch cable lengths
 - 1) Interior Ceiling Cameras: 100% shall be 1.5'
 - 2) Interior Wall Mounted Cameras: 100% 3'
 - 3) Exterior Cameras: 100% shall be 15'

- 5. IP Intercom Copper Patch Cables:
 - a. Patch cables shall be category 6A
 - b. Provide one patch cable for each IP Intercom device on the entire project, plus an additional twenty (20) for future use.
 - c. Patch cables to be installed by the IP Intercom System Installer.
 - d. Patch cable lengths
 - 1) Interior Ceiling Speakers: 100% shall be 1.5'
 - 2) Interior Wall Mounted Speakers: 100% 1'
 - 3) Exterior Speakers: 100% shall be 15'

- 6. MDF/IDF Fiber Optic Patch Cables:
 - a. Patch cables shall be OS2 (Single-mode).
 - b. Patch cable shall be duplex, LC to LC
 - c. Provide quantity sufficient for connecting all network equipment plus 20% for growth.
 - d. Patch cables to be installed by network equipment installer/programmer
 - e. Patch cable lengths
 - 1) 100% shall be 3 meters

- 7. Prior to submittal and procurement of fiber optic and copper patch cables, the contractor shall coordinate with the project Consultant and Owner of final requirement for cable lengths on the specific project.

1.5 SYSTEM SPECIFIC COLOR REQUIREMENTS

- A. The following information shall apply to the complete SCS Channel. All cable, patch cables, outlet terminations, and closet terminations shall be provided in the colors designated below:

| Item | Description | Horizontal Cable | Insert | Patch Cables |
|------|---------------------|------------------|--------|--------------|
| 1 | Data | Blue | Blue | Blue |
| 2 | VoIP Telephone | Blue | Blue | Blue |
| 3 | Wireless | Orange | Orange | Orange |
| 4 | Camera | Lilac | Lilac | Lilac |
| 5 | Access Control | Lilac | Lilac | Lilac |
| 6 | Intrusion Detection | Lilac | Lilac | Lilac |
| 7 | PA System | White | White | White |

1.6 DOCUMENTATION

- A. Labels:

The Contractor will label all outlets using permanent / legible typed or machine engraved labels approved by the Owner (no handwritten labels permitted). Label patch panels in the wiring closet to match those on the corresponding data outlets. The font shall be at least one-eighth inch (1/8") in height, block. All labels shall correspond to as-builts and to final test reports.

1. The following nomenclature shall be used when labeling data/voice jacks:
 - a. All cables being served by MDF closet shall begin with 'A' all IDF served cables shall begin with numerical digit 'B' thru 'Z') designating the specific IDF's identification.
 - b. Next identification character shall be a numeric digit identifying the specific patch panel that is serving outlet (1, 2, 3...)
 - c. Next identification shall note what # data port on patch panel (01 thru 48).

Example:

Label of an outlet from 23rd port of the third patch panel from top of rack located at IDF-2 shall read: C-3-23

Label of an outlet from the 5th port of the second patch panel from the top of rack located in the MDF shall read: A-2-05

- B. Floor Plan:
A floor plan clearly labeled with all outlet jack numbers shall be included in the as-built plans.
- C. Cables: All cables shall be labeled at both ends. This includes but not limited to horizontal voice and data cabling, copper backbone tie cables, and fiber optic cables.
- D. Fiber Optics: Fiber optic strands shall be labeled at both ends on the fiber distribution panel.
- E. Equipment racks: Equipment racks shall bear at least one indicating label indicated MDF or IDF. If rack is installed in IDF, label shall include IDF #.
- F. Access Points: Label ceiling grid with digital label according to location installed and a bright orange 3/4" round dot sticker.

**ATTACHMENT 'B'
MANUFACTURER AND MATERIAL LIST**

The Communications Contractor shall perform no portion of the work requiring submittal and review of record drawings, shop drawings, product data, or samples until the respective documentation has been approved by project's Technology Consultant.

MATERIAL LIST

| MANUFACTURER | DESCRIPTION | PRODUCT NUMBER | NOTES |
|----------------------|---|-------------------------|--|
| Commscope | 4-post Equipment Rack (45U) 12-24 Tapped Rails, Black | 760082560 RK4P45-36A | Provide as shown on Drawing, minimum of one (1) in the Building's MDF. |
| Commscope | 2-post Equipment Rack (45U) 12-24 Tapped Rails, Black | 760082479 RK3-45A | Provide as shown on Drawing, minimum of one (1) in the Building's MDF and each IDF. |
| Chatsworth | 12U-21U wall mount cabinet | 11996-7** | CUBE-iT wall-mount cabinet. Replace ** with 24 for tempered glad door for Press box application. Replace ** with 36 for IDF application. |
| Commscope | Vertical Cable Management Kit, 8in W X 84in H Single Sided, Black | 760244816 | Provide and install between each rack and at both ends of all rack systems |
| Commscope / Systemax | GigaSPEED X10D® XL® M4800 1U Modular Panel, 48 port, for SYSTIMAX Category 6A and 6 Jacks | 760105429 M4800-1U-GS | Provide in quantities as required to terminate 100% of all distribution structured cabling, plus 25% for future growth. Reference project drawings. Voice/Data, Security, and WLAN shall have dedicated panels per system. |
| Commscope / Systemax | GigaSPEED X10D® XL® M2400 1U Modular Panel, 24 port, for SYSTIMAX Category 6A and 6 Jacks | 760118323 M2400-1U-GS | Provide in quantities as required to terminate 100% of all distribution structured cabling, plus 25% for future growth. Reference project drawings. Voice/Data, Security, and WLAN shall have dedicated panels per system. |
| Commscope | Copper Ground Buss Bar, 1/4 in x 4 in x 12 in | UGBKIT-0412 | Provide one (1) in each MDF and IDF on the entire project |
| Commscope / Systemax | High Density 1U modular cassette sliding Panel, accepts (4) G2 modules or MPO panels, providing up to 48 duplex LC ports, or up to 32 MPO ports | 760209940 HD-1U | Provide as per the project drawings. Or as required, to accommodate all fiber optics in the IDFs, if not shown on drawings |
| Commscope / Systemax | High Density 2U modular cassette sliding Panel, accepts (8) G2 modules or MPO panels, providing up to 96 duplex LC ports or up to 64 MPO ports | 760209957 HD-2U | Provide as per the project drawings. Or as required, to accommodate all fiber optics in the MDF/IDFs, if not shown on drawings |

| MANUFACTURER | DESCRIPTION | PRODUCT NUMBER | NOTES |
|----------------------|---|-----------------------------|--|
| Commscope / Systemax | High Density 4U modular cassette sliding Panel, accepts (16) G2 modules or MPO panels, providing up to 192 duplex LC ports or up to 128 MPO ports | 760209965 HD-4U | Provide as per the project drawings. Or as required, to accommodate all fiber optics in the MDF/IDFs, if not shown on drawings |
| CommScope | Rear cable management, rack mountable | 360-RCM-RM (760104737) | |
| CommScope | Rear cable manager bar, 19in, 5in deep | NETCONNECT (557548-1) | |
| Commscope / Systemax | 360 Distribution Adapter Pack, Singlemode, 12 LC with internal shutters | 760109389 360DP-12LC-SM | Provide as required to accommodate 110% of all fiber terminated in each MDF/IDF |
| Commscope / Systemax | 360 Distribution Adapter Pack, Singlemode, 24 LC with internal shutters | 760115915 360DP-24LC-SM | Provide as required to accommodate 110% of all fiber terminated in each MDF/IDF |
| Commscope / Systemax | Category 5e PowerSUM 1100 U/UTP Patch Pane, 24-port | 760182907 1100-U-PS-24 | Provide in quantities as required to terminate 100% of all copper backbone cable. Reference project drawings. |
| Commscope / Systemax | GigaSPEED X10D@ 360GS10E Solid Cordage Modular Patch Cord | CPCSSX2-0xFyyy | x' to be replaced with alpha or numeric character depicting the color of the patch cable. 'yyy' to be replaced with a numeric value depicting the patch cable length, in feet. Colors shall comply with designated color of the system each cable is provided for. Length to comply as stated in these specifications and coordinated with the Owner's Technology department |
| Commscope / Systemax | CommScope® Category 6A U/UTP Cord, Plenum , RJ45 to Ceiling connector, 1.5 ft, WHITE | CCA-CAT6A-PLENUM-WHITE-N018 | Provide for all above ceiling terminations (IP Intercom Speakers, Wireless Access Points, Video Surveillance Cameras, etc.) |
| Commscope | 10 ft. x 12 in Ladder Rack Straight Section, Black | 760085647 CR-SLR-10L12W | Provide as shown on drawings. Tray shall route to and between all racks, in each MDF/IDF, on the entire project. |
| Commscope | Ladder Rack, 90° radius, Horizontal E-Bend Section, 12", Black | 760085530 CR90FCB-12W | |
| Commscope | Ladder Rack Inside Curved Section, 12", Black | 760085688 CR90ICB-12W | |

| MANUFACTURER | DESCRIPTION | PRODUCT NUMBER | NOTES |
|----------------------|--|-------------------------|--|
| Commscope | Ladder Rack Outside Curved Section, 12", Black | 760086082 CR90OCB-12W | |
| Commscope | Rack-to-Runway Mounting Kit, black in color | 760084053 CRR2RRMK | Provide one (1) at the top of each rack and/or cabinet on the entire project. |
| Commscope | Ladder Rack wall angle support kit, 12", black | 760084145 CR6-12WRSK | Provide one (1) at each location where the ladder tray system terminates at a wall |
| Commscope | Ladder Tray Triangle Support Bracket, 12", Black | 760084095 CRTWSBK-12W | Provide every 5' of horizontal ladder tray section routing along the communication room walls. |
| Commscope | Vertical Wall Bracket | 760084137 CRVWBK | Provide one kit every 5' of vertical wall ladder rack, minimum of two kits at top and bottom. Contractor to provide vertical wall cable tray section at locations where the service entrance and backbone thru-floor sleeves are located |
| Commscope | Ladder Rack protective end cap kit (2 caps), black | 760084012 CRPECK | Provide one kit at each exposed end of ladder rack |
| Commscope | Ladder Tray, junction splice kit, black | 760084046 CRTJSK | |
| Commscope | Ladder Rack, butt splice kit, black | 760083899 CRBSK | |
| Commscope | Ladder Tray Radius Drop Kit, 12", Black | 760083956 CRDK-12W | Provide one (1) at each location where cable drops to the rack associated rack. |
| Commscope | Ladder Rack Retaining Post Kit | 760083980 CRRP-8H | Provide one (1) set at all ladder rack junctions and horizontal bends to prevent cable from dropping off thru ladder rack system. |
| Commscope / Systimax | GigaSPEED X10D® 2091B ETL Verified Category 6A U/UTP Cable, 4 pair count, 1000 ft length, WE TOTE® box | 2091B ** 4/23 W1000 | ** to be replaced with numeric character depicting the color of the cable. Colors shall comply with designated color of the system each cable is provided for. **=Blue for voice/data **=Purple for security cameras, door access **=Orange for wireless **=White for intercom |
| Commscope / Systimax | GigaSPEED X10D® MGS600 Series Information Outlet | MGS600-yyy | yyy' to be replaced with numeric character depicting the color of the Information Outlet (IO). Colors shall comply with designated color of the system each IO is provided for. Yyy=262 for white for intercom Yyy=318 for blue for data yyy=361 for violet for cameras, |

| MANUFACTURER | DESCRIPTION | PRODUCT NUMBER | NOTES |
|-------------------------|---|---------------------------------------|---|
| | | | access control yyy=112 for orange for wireless |
| Commscope / Systimax | Single Gang, Stainless Steel, M-Series Faceplate | M1*SP | * to be replaced with a numeric character that depicts the port quantity of the faceplate. All faceplates shall be a minimum of 4-ports, with the exception of specialty outlets such as Wall Phones, Wireless Access Points, Video Surveillance Cameras, etc. |
| Commscope | TeraSPEED® Plenum Distribution Cable, interlocking aluminum armored with plenum jacket, 12 fiber | 760127803 P-012- DZ-8W-FSUYL | |
| Commscope | 48 Fiber, Single Jacker/Single Armor, Gel-Free, Outdoor stranded Loose Tube Cable, Single Mode | 760053280 D-012- LA-8W-F12NS | |
| Commscope | 12 Fiber, Riser Rated, Distribution cable, SM | 760086371 R-012- LN-8W-F12BK/25D | |
| Commscope | Field Installable LC Connector, SM- UPC, Blue, for 250/900u | 760117895 SFC- LCF-09-8X | 1 per pack |
| Commscope | Field Installable LC Connector, SM- UPC, Blue, for 250/900u | 760117895 SFC- LCF-09-8X-25 | 25 per pack |
| Commscope | Singlemode LC to LC, Fiber Patch Cord, 1.6 mm Duplex, Riser | FEWLCLC42-JXM*** | *** to be replaced with a numeric value depicting the cable length in meters |
| | | | |
| Commscope | 25-Pair PowerSUM U/UTP 2061F Series Plenum Cables | 2010B WH 25/24 R##### | Provide one (1) from the MDF to each IDF on the entire project. ##### to be replaced with numeric characters that depict the cable length |
| Panduit | LD non-metallic series low voltage, one-piece hinged design, single channel surface raceway includes adhesive backing and is made of impact resistant material with a smooth finish that will not scratch, peel, or corrode. The raceway includes an assortment of bend radius and standard fittings that complement the offering to help route, protect, and conceal low voltage data, voice, and video cabling | Pan-Way LD surface raceway system. | Coordinate with architect and owner on color. |

| MANUFACTURER | DESCRIPTION | PRODUCT NUMBER | NOTES |
|--|--|--|---|
| Dynacom | Unwired, 66-Style Termination Block with clear, hinged cover | 66M1-50 | Provide one (1) for each 25-pair demarcation extension cable |
| Dynacom | 66 wiring block, metal backboard, blue in color | 183C*M | * to be replaced with a numeric value depicting the board size. Provide at each demarcation point for the mounting of the 66 wiring blocks. Board size shall consist two (2) mounting brackets per 25-pair cable installed. |
| Ditek | 10GbE, Single Channel, RJ45/RJ45, PoE Surge Protector, STP Category 6/6A | DTK-MRJPOES | Provide one for each copper network cable associated with an exterior device, up to two (2) cables. Bond to TGBB per manufacturer's instructions |
| Ditek | Rack Mount, 10GbE, 12-Channel, RJ45/RJ45, PoE Surge Protector, STP Category 6/6A | DTK-RM12NETS | Provide one for every four (4) to ten (12) copper network cables associated with an exterior device and originating at the same MDF/IDF. Bond to TGBB per manufacturer's instructions |
| Ditek | Rack Mount, 10GbE, 24-Channel, RJ45/RJ45, PoE Surge Protector, STP Category 6/6A | DTK-RM24NETS | Provide one for every Thirteen (13) to Twenty-Four (24) copper network cables associated with an exterior device and originating at the same MDF/IDF. Bond to TGBB per manufacturer's instructions |
| EXTENDED DISTANCE POWERED FIBER FOR WIRELESS AP AND VIDEO SURVEILLANCE CAMERAS | | | |
| CommScope | Power Express Distribution shelf with alarm module | PFP-PX-S1 | Power Express Class 2 shelf and starter kit, accommodates up to 4 modules of 8 SELV/Class 2 outputs, 1U |
| CommScope | Power Express Distribution module. | PFP-PX-8M | |
| CommScope | Power Express Blank Slot Panel | PFP-PX-SF | Provide one (1) for every empty slot. |
| CommScope | SPS Rectifier Power Distribution Shelf | PFP-SPS-1 | |
| CommScope | 1600W SPS Power Rectifier module | PFP-SPS-1600M | |
| CommScope | SPS Rectifier Controller Display | PFP-SPS-C1 | Provide one per SPS Rectifier Power Distribution Shelf |
| CommScope | SPS Rectifier Blank Slot Panel | PFP-SPS-SF | Provide one (1) for every empty slot. |
| CommScope | CS340 Category 6 U/UTP filled Cable, outdoor direct burial, black jacket, 4 pair count, 1000 ft (305 m) length, reel | UN884019904/10 CS340 BLK C6 4/24 U/UTP RL 1KFT | |
| CommScope | OS2, Outdoor, 4-Strand Fiber | PFC-S04012 | |
| Transition Networks | Gigabit SFP Module | TN-GLC-LH-SM. | Provide one (1) for each POE extender. |

| MANUFACTURER | DESCRIPTION | PRODUCT NUMBER | NOTES |
|--------------|--|------------------|-------|
| CommScope | PoE Extender, 2 Port Universal Mount, Outdoor, 60 Watt, 2-Port | PFU-P-C-0-060-02 | |
| Hoffman | 22" X "22" back panel | CP2424 | |
| Hoffman | 24"x24"x8" NEMA-4 junction box. | CSD24248 | |
| Hoffman | Padlock Handle | CWHPTO | |

END OF SECTION

SECTION 27 41 16.20 -LOCAL SOUND REINFORCEMENT SYSTEMS

PART 1 – GENERAL

1.1 RELATED WORK

- A. The following sections shall associate with this specification as applicable.
1. General Conditions
 2. Supplementary Conditions
 3. Division 1
 4. Division 26 in its entirety.
 5. Division 27 in its entirety.
 6. Division 28 in its entirety.

1.2 DESCRIPTION

- A. Summary of Work:
1. Provide all equipment specified well as all miscellaneous parts and materials required for the proper, complete, and functional Video and/or Sound Distribution System at the following Venues:
 - a. Cafeteria
 2. All applicable equipment shall bear the UL label.
 3. 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.
 4. Locate equipment to accommodate millwork, fixtures, marker boards and other room equipment at no additional cost to the owner.
 5. Plenum rated cable may be used as an option at the contractor's discretion. Wherever cabling is run exposed, conduit shall be used to cover and protect wiring.
 6. These documents are conceptual in nature. It shall be the responsibility of the approved installer to furnish a complete and functional system, including the items shown on the drawings, in the specifications, and items not designated in either. The installer's shop drawings and product data submittals shall represent a complete system and documents accepted do not relieve the installer from being required to provide any materials, equipment, or labor to furnish a complete and functional system as recognized by the Project's Technology Consultant and the Owner.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications:
1. The contractor providing and installing the integrated audiovisual systems and associated infrastructure shall be an authorized dealer of the specified projector manufacturer and be capable of providing the manufacturer's maximum available product warranty.
 2. All individuals installing the audio-video system must be employees of the authorized dealer and at least 75% 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.
 3. The proposing contractor and the installing contractor must be the same company. No subcontractor to the proposing audio-video contractor will be

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- allowed for any portion of the audio-video scope of work.
4. The System Installer shall meet all applicable regulations of the State and Department of Labor insofar as they apply to this type of system. The bidder shall be a firm normally employed in the audio-video industry and shall provide a reference list of ten (10) projects of equivalent size or larger and contact names confirming successful completion of projection system installations.
 5. The bidder shall have an authorized service center, within 75-miles of the project's location, for the brand of equipment that is submitted for bid. The Owner, Architect, and Consultant reserves the right to perform an onsite inspection as they deem necessary.
 6. The bidder must produce a letter from the manufacturer guaranteeing the delivery of all the equipment outlined in the specification herein.
 7. The bidder shall have a full-time local service personnel capable of servicing the projector system described herein.
- B. Pre-Construction Meeting:
1. The successful Contractor shall attend a mandatory pre-construction meeting with individuals deemed necessary by the Owner's representative prior to the start of the work.
 2. The contractor shall provide a mockup of the complete integrated audiovisual system solution for each of the typical spaces below before implanting the installation in multiple like rooms. Mockup shall include all products listed in part 2 of this specification. Coordinate with G.C., Architect, Consultant, and Owner for scheduling and location of mockup.
 3. All proposing contractors must have ability to demonstrate a/v system being proposed and provide owner with completely installed system to evaluate performance and operation.
- C. Acceptance: The Owner's representative reserves the right to reject all, or a portion of the work performed, either on technical or aesthetic grounds.
- D. Warranty:
1. The selected system installer shall be factory authorized service center and shall provide an end-to-end performance warranty of not less than one (1) year. The proposer shall provide current certification documentation. The performance warranty shall be issued by the manufacturer and shall warrant that video projection system projectors have been tested to the district's approval. This end-to-end warranty shall cover the labor associated with removing/reinstalling any associated hardware or equipment as well as the replacement of all defective equipment or hardware.
 2. The bidder shall also submit with the materials mentioned in section 1.5 submittals of this specification a written explanation outlining the terms and conditions of product warranty of all parts and service of the integrated a/v solutions.

1.4 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. National Electrical Code, current version
- B. 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.
- 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 and regulations.

1.5 ABBREVIATIONS

- A. The following abbreviations are used in this document:
1. AV-# Audiovisual input station / Presentation Station (Reference drawing legend) CMP Ceiling Mounted Projector LCD or LED Flat panel screen/monitor

1.6 SUBMITTALS

- A. Project Initiation: Within fourteen (14) days of Notice to Proceed, the projection 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, speakers, amplifiers, cable, 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.
 3. 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.
 4. Testing: Proposed Contractor test result forms, and a list of instrumentation to be used for systems testing.
 5. The contractor shall provide a letter from the manufacturer stating that the dealer is an authorized service center.
 6. The resume and contact information of the full-time service personnel responsible for the installed projection system.
 7. Specification Compliance: A letter shall be provided stating, by section and subsection, that the 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.
 8. 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.
- a. AMX authorized dealer certification
 - b. Installer training certification: 1) Provide specification with line-by-line acknowledgement of compliance.
- B. Shop Drawings: Submit the following items, for Owner review and approval, within twenty-eight (28) days of notice to proceed:
1. Proposed wiring and connectivity diagram of the proposed projection system including all faceplates and sound reinforcing equipment
 2. In addition to the wiring/connectivity diagram, the submitted drawings shall indicate the following, even if the following is expected to be provided by the project's electrical or general contractor:
 - 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
 - e. 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)
 - f. Conduit routing, size, quantity, and stub-up locations for all floor mounted outlets.
 3. Drawing Compliance: A letter shall be provided stating that the 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. Project Completion: As a condition for project acceptance, the Contractor shall submit the following for review and approval:
1. Samples: Complete manufacturer's product literature and samples (if requested) for all pre-approved substitutions to the recommended products made during the course of the Project.
 2. 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.
 3. Operating and Maintenance Instructions: 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 on disc or USB drive with the project name and description (2 copies).
 4. Provide schematic line diagram of system components as deployed in each installation.

PART 2 – PRODUCTS

2.1 GENERAL

All products listed in this section shall be provided and installed by the contractor unless

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otherwise noted below. The following list is not intended to be a complete list of required equipment or cables as the project is to be Turnkey and may require equipment beyond the depth of this list. It is the contractor's responsibility to ensure that they are providing a complete and functional system with their proposal.

- 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.
- 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
 - b/ 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 TRAINING

- A. A minimum of eight hours for instruction in proper operation and routine maintenance of the system. Instruction shall cover all materials indicated in the Owner's operations manual.
- B. Operational guidelines shall be given in written form in sufficient numbers so that all key personnel 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.

2.3 WARRANTY

- A. One year from Date of Substantial Completion

2.4 PRODUCTS AND MATERIALS

- A. Local Sound Reinforcement System
1. Rack Mount Amplifier: - DSP & Amplifier by Harman or pre-approved equal.
Three mic jacks, (1) in riser and (1) on either side of stage ATLAS S501-13C
 2. Three (3) Microphones Shure PGA 58-LC
 3. Three (3) Atlas MS-18C stand
 4. Three (3) Generic 25'-0" microphone chords
 5. One (1) Atlas DS-5 Desk Stand
 6. Digital Wireless Mic System – Shure QLX/ULX Wireless
 - a. Two (2) receivers
 - b. Two (2) Handheld Transmitters
 - c. Two (2) Belt Pack Transmitter
 - d. Two (2) WH 30 Head worn Mic
 - e. Two (2) WL 185 Lapel Mic
 - f. Active Directional Antenna
 7. Wall Cabinet to house all local sound equipment.
- B. Cafeteria, Teaching Theater, Large Group Instruction Speakers: ATLAS SOUND or JBL Series, 8 - inch coaxial, 8 watt, 70v Transformer. Include back box and baffle; provide ATLAS Tile
- C. Gymnasium speakers:
1. Middle School: Provide at center court and suspend from ceiling 4 each JBL AC2215/64 Black or White; 2 each JBL AL8115 Black or White.
 2. High School: Provide in both Performance and Auxiliary Gymnasiums. 10 each JBL AC2215/64 Black or White; 2 each JBL AL7115 Black or White. 4 speakers each side to cover bleachers and 2 facing center court: 2 subs, 1 facing each side in center of gym. No center cluster of speakers.
- D. Hearing Assist System – The hearing assist system is to consist of a FM transmitter with one antenna. The transmitter will broadcast in the FM band from 72.1 MHZ to 75.9 MHZ.
1. Williams Sound PPA L157 system with PPAR35 receivers, one RPK005 rack mount kit and one ANT005 whip antenna
- E. Athletic Field P.A. System:
1. Amplifier: QSC 4-channel PLD 4.2 or similar product
 2. Rack: Middle Atlantic DTRK-718 or similar product
 3. Mixer: Art MX622 or similar product
 4. Wireless Microphones: Two (2) Shure QLX/ULX wireless mics
 5. Exterior mounted speakers- JBL AWC 129 BK
 - a. Mount speakers on front of press box: two speakers on each side, mounted horizontally one over the other. Speakers must be mounted to move left and right horizontally.
 6. Wall mounted equipment (in the knee space in center of press box)
 - a. One Mic Jack Plate
 - b. One L-R Aux input plate (2 RCA audio jacks)
- F. Pool P.A. System:
1. Speakers: EV EVID 6.2 or equal. Black colored speakers mounted on brackets to cover pool areas. 8 to 10 speakers in typical systems.
 2. Amplifier, mixer, DSP equipment by QSC, Harmon or equal. Rack for equipment to mounted in area oust the pool area.

LOCAL SOUND REINFORCEMENT SYSTEMS

274116.20-6

Salas O'Brien Registration #F-4111

3. Wireless microphones: ULX or QLX Shure microphone system with handheld and belt packs.

PART 3 – EXECUTION

3.1 GENERAL

- A. Contractor is required to properly mount integrated A/V solutions and connect all ceiling video / audio cables to projector component inputs.
- B. Contractor is required to thoroughly test and verify operation of all A/V inputs and video modes prior to project completion.
- C. Contractor is required to focus and adjust projector to properly project image on viewing surface (screen or multimedia board depending on location).
- D. Contractor shall provide owner with written verification test process and results once all projectors have been installed, tested, and placed in final condition.
- E. Damage: 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).
- F. 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. Contractor shall provide owner with detailed serial number listing and associated graphical room number designation equipment was installed. Contractor shall use actual graphical package room numbers not architectural plan numbers from construction set.

3.3 STATION WIRING INSTALLATION

- A. General: 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 all category 6 cable. There shall never be more than one and one-quarter inch of unsheathed enhanced Category6 UTP cable at either the wiring USB Transmitter or Receiver.
- B. Exposed Cable: All cabling shall be installed inside walls or ceiling spaces whenever possible. Exposed station cable will only be run where indicated on the Drawings. 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 an approved J-Hook cable support. Cable supports 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. Contractor shall adhere to the manufacturer's suggested fill ratio for each size cable support installed.

2. Attaching cable to pipes or other mechanical items is not permitted. 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 routed down the corridors; parallel or perpendicular to building structure. Multiple cables to be bundled together at and between each cable support installed.
3. Contractor shall be responsible for coordinating with other trades on the project so that the installed cable pathway does not interfere with the installation of other systems to ensure that mechanical ducts, pipes, conduits, or any other above ceiling systems are not putting unnecessary stress on any portion of the install audio-video cabling.

3.4 STATION HARDWARE

- A. Flush mounted components: all components shall be inserted to a flush mounted faceplate unless designated otherwise.
- B. Placement: Where possible, the AV input outlets 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. The CMP outlet shall route directly to the rear of the projector and does not require any type of faceplates.

3.5 PROGRAMMING

- A. Programming shall be coordinated with the Owner and Project's Consultant. Programming shall include, but not be limited to the following:
 1. AV Control Panel Configuration
 2. Audio routing from any source location through the DSP
 3. Projector and screen control via the Audio / Video Control panel
 4. Device resolution and over/under-scanning settings
 5. Incorporation of any Owner furnished source equipment (maximum of 3)

3.6 FINAL 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. Testing procedures shall consist of, but not be limited to the following:
 1. Input locations to be tested utilizing multiple types of source equipment.

Equipment to include:

- a. Personal Computer (laptop)
 - b. Apple iMac
 - c. Apple Mac Mini
 - d. Google Chromebook
 - e. Additional devices may be required at the time of testing
 - f. contractor to provide devices on a single cart, to roll between inputs during testing.
2. Routing of video, from any source to each projector and display simultaneously and independently.
 3. Routing of audio, from any source to each audio channel simultaneously and independently.
 4. Control of the entire system from each installed A/V Control Panel
 5. Additional test requirements may be required at the Owner and/or Consultant's request.

3.7 OWNER TRAINING AND DEMO

- A. A/V integrator shall provide demonstration of all integrated a/v solutions to owner's staff that have any stake with the operation and maintenance of the a/v solutions. Integrator shall produce sign in sheets for record of who was trained and when. Copies of sign in sheets shall be submitted with close out paperwork. Coordinate training dates with owner at project completion.
- B. Integrator shall provide factory training for owner's operations and maintenance personnel for each major component of the systems listed in the A/V solutions outlined in part 2 of these specifications. Training shall be a minimum of 4 hrs. per person. Re-training of staff shall be available, at no cost to the owner, to a maximum of 3 on-site training sessions up to 1 year from the date of project competition.
- C. All training is to be recorded via video recording and a copy of the recorded video shall be provided to the owner upon completion. All video recording equipment, for the recording of training, shall be provided by the integrator.

END OF SECTION

SECTION 274134 - AV SYSTEMS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. All requirements under Instructions to Bidders, General Conditions, Supplementary Conditions, Special Conditions, Division One, Technical Specifications, Referenced Documents or Practices and any Addenda of these Specifications will be a part of this section. The Contractor is responsible to be thoroughly familiar with all its contents as to requirements which affect this Division or Section.

1.2 RELATED DOCUMENTS

- A. AV Drawings.
- B. Specification Sections:
 - 1. 26 60 01, Technical Reference.
 - 2. 27 05 29, Pathways for AV Systems.
- C. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Divisions 00 and 01 Specification Sections, apply to this Section.

1.3 REFERENCES

- A. National Fire Protection Association (NFPA).
 - 1. NFPA 72 *National Fire Alarm and Signaling Code*, as adopted and/or amended by the Authority Having Jurisdiction (AHJ).
 - 2. NFPA 101 *Life Safety Code*, as adopted and/or amended by the Authority Having Jurisdiction (AHJ).
- B. Building Codes.
 - 1. International Building Code.
 - 2. State and Local Building codes as adopted and/or amended by the Authority Having Jurisdiction (AHJ).
 - 3. Americans with Disabilities Act (ADA) and/or State and Local equivalency standards as adopted by the AHJ.
- C. Owner Standards Documentation.
- D. Audio Video Integrated Experience Association (AVIXA).
 - 1. F501.01: 2015, Cable Labeling for Audiovisual Systems.
 - 2. F502.01: 2018, Rack Building for Audiovisual Systems.
- E. National Cable Television Association (NCTA).
- F. Society of Motion Picture and Television Engineers (SMPTE).
- G. International Telecommunications Union (ITU).

1. BT.709-6: 2015, Parameter Values for the HDTV Standards for Production and International Programme Exchange.
2. BT.2020: 2015, Parameter Values for Ultra-High-Definition Television Systems for Production and International Programme Exchange.

1.4 DEFINITION OF TERMS & ABBREVIATIONS

- A. Provide: to supply and install.
- B. Furnish: to supply to another contractor for installation.
- C. Supply: to supply but not install.
- D. Install: to install but not supply.
- E. OFOI: Owner Furnished Owner Installed.
- F. OFCI: Owner Furnished Contractor Installed.
- G. NIC: Not In Contract. Refers to items that are not included in the scope of work outlined in this section but may be shown for coordination purposes or reference.
- H. Future: Equipment that will be provided by owner later. Accommodations shall be provided for future equipment as shown on the drawings.

1.5 RESPONSIBILITY AND RELATED WORK

- A. The written specification and drawings AV-001 through AVD-210-F will be collectively referred to herein as the Contract Documents.
- B. The systems described in this section will be called the "AV Systems" and the installer will be named "The Contractor."
- C. The Contractor must provide all labor, materials, equipment, necessary tools, test equipment, hoisting, transportation, supervision and coordination necessary to complete the installation of the "AV Systems" as described in these specifications and illustrated on the Project drawings.
- D. Contractor shall provide, based on the Contract Documents, a complete, turnkey system, tested and ready for acceptance testing. The Contract Documents are developed to the extent required to properly convey design intent, signal flow, and system infrastructure. Contractor will supply any additional equipment required to provide a complete and working system.
- E. Contractor will supply any accessories, such as power supplies, adaptors, connectors and converters, required to provide a complete and working system.
- F. System features or devices which are mentioned in one part of the Contract Documents may not be shown in the other. In case of conflict between the written specifications and the drawings, Contractor must seek clarification from the Consultant. If the Contractor fails to obtain such clarification, the interpretation of the Consultant will prevail.
- G. Contractor shall obtain all licenses and permits necessary for the execution of any work pertaining to the installation within this scope of work.

- H. Contractor shall comply with all union jurisdiction and prevailing wage requirements.
- I. Refer to AV-001 for division of responsibilities related to the AV Systems.
- J. Turn over all existing equipment to Owner.

1.6 SYSTEM DESCRIPTION

A. Auditorium

1. Projection System

- a. A laser projector shall be mounted from the ceiling within the cafeteria. Projector to utilize a 16,000 ANSI lumen laser lamp & to feature full HD WUXGA and have support for 4K content.
- b. A 226" diagonal 16:10 aspect ratio motorized projection screen shall be attached from above.
- c. Primary equipment shall be housed in an AV equipment rack located in a nearby storage closet. (4) extended HDMI inputs shall be provided within the cafeteria will connect to a video matrix switcher. Extended connections to terminate to a video matrix processor located in the associated equipment rack & extend to the ceiling suspended projector.

2. Sound System

- a. Large, point source loudspeakers shall be oriented in a left | right | center stereo configuration on either side of the platform proscenium opening. (1) dual 15" subwoofer shall be mounted above the proscenium opening. Speakers & subwoofers shall be powered by networked amplifiers located in the associated equipment rack. Additional ceiling speakers will be provided at the rear of the room for supplemental coverage.

3. Wireless Microphone System

- a. All of the existing wireless microphones will be uninstalled from their existing location and be installed in the AV rack for reuse.

4. (2) wall boxes shall be located downstage, (1) wall boxes shall be located at the front lip of the stage, & (1) wall boxes shall be located at the back of the cafeteria.

5. Audio Mixing System

- a. The existing console and existing digital stage box (mounted in a portable rack) to be reused for events requiring a more in-depth audio setup. The console will connect to the audio network via the data connections on the wall plates throughout the space. A loose touch panel will be provided for use with the audio console.

6. A Bluetooth input panel shall be located adjacent to the stage wall mounted touchscreen controller & connected to the associated audio DSP. A rack mounted CD player shall be provided for legacy audio playback.

7. AV Network

- a. An AV network switch shall be provided for local DSP, amplifier, touchscreens, Bluetooth, and matrix video switcher interconnectivity.

8. Intercom System

- a. A wireless intercom system will be provided for staff/operators; a master intercom station will be located in the AV equipment rack with an antenna in the ceiling for wireless transceivers.

9. Assistive Listening System
 - a. A wireless transmission system with receivers will be provided for those hard of hearing.
 - b. Quantity of required devices dictated by local codes.
10. Wall mounted touch panel controllers will control all AV devices within the space from the rear of the room and the stage.

B. Blackbox

1. Sound System
 - a. Full-range speakers will be suspended from the pipe grid located in either of the four corners of the room.
 - 1) Speakers will be actively amplified by integrated amplifiers.
 - 2) Speakers will be suspended from the pipe gride with pipe mounting hardware and be portable for user definable relocation of speakers.
 - b. Local DSP will be provided.
 - c. Emergency paging for campus wide announcements to override content playback.
2. Audio Mixing System
 - a. Mixing of local I/O will be from a digital mixing console located in the control room.
 - b. Remote I/O will be located in the associated AVL equipment room and connect to I/O from the local in room wall and pipe mounted boxes.
 - 1) Remote I/O will consist of Dante connectivity.
3. Bluetooth input panel will be located in the room.
4. Wireless Microphone System
 - a. (4) Channels of digital wireless microphones will be provided.
 - 1) Receiver(s) will be located in the associated AVL equipment room.
 - 2) Antennas will extend from the associated AVL equipment and utilize wall mounted antenna.
 - 3) Transmitter will consist of (2) body packs with headset microphones and (2) handheld microphones.
 - 4) A rechargeable battery system will accompany the transmitters.
 - 5) Chargers mounted to sliding shelves located in the AVL equipment room.
5. Assistive Listening System
 - a. A wireless transmission system with receivers will be provided for those hard of hearing.
 - b. Quantity of required devices dictated by local codes.
6. Projection System
 - a. Projection screen will consist of (1) 159" diagonal, 16:9 aspect ratio, motorized projection screen.
 - 1) Projector screen will be controlled via IP connectivity.
 - 2) Projector screen will be suspended from the pipe gride with pipe mounting hardware and be portable for user definable relocation of projection screen.
 - b. Projector will consist of (1) 13,000 ANSI lumen Full HD WUXGA laser light source projector.
 - 1) Projector will be controlled via IP connectivity.
 - 2) Projector will be suspended from the pipe gride with pipe mounting hardware and be portable for user definable relocation of projection.

- c. The projection systems primary inputs will be driven by the provided video over IP distribution system and have associated HDMI inputs on input panels. Inputs will include the following and be encoded into the IP distribution system:
 - 1) (6) extended HDMI inputs will be provided.
 - 2) (1) rack mounted wireless presentation gateway will be provided
 - d. Video system will be automated with preset recalls available from the AV control system. Automation will include projection screen controls and routing of all associated video input to the projector and other distributed displays.
7. Camera System
- a. A point-of-view (POV) static camera package will consist of four fixed cameras.
 - 1) Cameras will feed a multi-viewer.
 - 2) The output of the multi-viewer will feed the video IP distribution.
 - 3) Compact monitors will be provided at the operators positions and connect to the video IP distribution.
8. Intercom System
- a. A wireless intercom system will be provided for staff/operators; a master intercom station will be located in the AV equipment rack with an antenna in the ceiling for wireless transceivers.
9. Wall mounted equipment rack will be provided in the control room for AV equipment.
10. Local control of the AV system will utilize the local touchscreens and OFE provided wireless tablets with provided control system applications.

1.7 PRE-BID SUBMITTALS

- A. Bid Clarifications. Contractor is responsible for reading and understanding all information presented in these specifications and related documents outlined in Section 1.2. Discrepancies between drawings and specifications or other errors or omissions should be brought to the Consultant's attention a minimum of 5 days prior to bid date. Failure to do so does not relieve the Contractor from the requirement to provide a fully operational and turnkey system as outlined above. In this event, the Contractor agrees to abide by the decision of the Consultant for resolution.
- B. Contractor Qualifications. Contractors will be considered by the Owner and Consultant upon receipt of the following information:
 - 1. Company profile including history, number of employees, facility size and completed projects.
 - 2. Resume of key personnel to be used on this project, including but not limited to: Project Manager; Lead Engineer; Job-Site Superintendent.
 - 3. Contractor shall have previously installed at least three jobs of similar magnitude, completed within the last five years. A resume shall be provided for these projects including project name, scope of services, year completed, and contact information for a reference. Provide at least one such completed job for inspection by the Architect and/or Consultant.
 - 4. Contractor shall have five years of experience with equipment and systems of the types specified, shall maintain a fully staffed and equipped service facility, and shall be a franchised dealer and authorized service facility for the major brands specified, and shall be properly licensed to work I at the project location.
 - 5. A description of the Contractor's abilities for in-shop assembly, fabrication, and testing.
 - 6. A sample set of shop drawings or as-built documents that confirm the Contractor's capabilities to provide engineering and documentation for the project.

7. A line sheet listing all manufacturers the Contractor is a dealer and/or authorized service center for.

1.8 BID SUBMITTAL

- A. Submit according to conditions of the Construction Contract and Project Manual.
- B. The Bidder shall disclose in the bid whether any portions of the project work will be subcontracted out. All terms of this contract, including bidding and qualification statements, shall apply to the subcontractor. Provide the following information for each subcontractor to be used:
 1. Name of the proposed subcontractor.
 2. A statement of qualifications for each subcontractor.
 3. A scope of work outlining what portions of the project for which the subcontractor will be responsible.
- C. Include the following information with the bid submittal:
 1. The total contract price.
 2. The price for any add or deduct alternates.
 3. An itemized equipment list which includes unit pricing for all equipment.
 - a. List to be presented in the same sequential order as in Part 2 below.
 4. A breakdown of the cost and number of labor hours for each of the following:
 - a. Engineering and documentation.
 - b. On site coordination meetings and supervision.
 - c. In shop fabrication and assembly.
 - d. On site fabrication, assembly, and installation.
 - e. On site verification and testing.
 - f. Contractor tests and adjustments as outlined in Section 3.7.
 - g. Manufacturer training, inclusive of travel expenses.
- D. Substitutions. Contractor shall note all substitutions at the time of bid. Comply with General Conditions. Any proposed substitutions must meet all specifications of the specified equipment. No product substitution will be accepted without the written approval of the Consultant or Owner. Consultant and Owner retain the right to reject any proposed substitution.

1.9 PROJECT SUBMITTALS

- A. Submit according to conditions of the Construction Contract and Project Manual.
- B. Each submittal shall be as a coordinated package complete with all required information. Uncoordinated sets will be returned without review.
- C. Product Data.
 1. Submit manufacturer's product data sheets for each item of equipment that will be provided as part of this contract for approval prior to purchase of equipment.
 2. Submit electronically as a single PDF. All equipment cut sheets will be arranged per specification section number. Provide a table of contents and a bookmark at the start of every product sheet.
 3. Failure to submit without time for evaluation shall not entitle the Contractor to purchase, substitute product or delay the project's delivery product without approval.

- D. Color Submittal.
1. Submit according to conditions of the Construction Contract and Project Manual.
 2. Organize according to location, device, and color option.
 3. Where custom colors have been specified, include the appropriate reference (RAL, Pantone, etc).
 4. This shall include but not be limited to: floorbox lids, wall mounted devices and panels, ceiling mounted devices and panels, and loudspeakers.
- E. Millwork Colors and Samples. Submit according to conditions of the Construction Contract and Project Manual.
- F. Shop Drawings.
1. Review of shop drawings is for general conformance with the design intent and general compliance with the contract documents of the project. Corrections, comments, or markings made do not relieve the Contractor from compliance with the Contract Documents nor allow departure therefrom. Contractor remains responsible for detailing and accuracy, confirming and correlating quantities and dimensions, selecting fabrication processing and techniques of construction, coordinating work with that of other trades, and performing work in a safe a satisfactory manner.
 2. Failure to submit shop drawings without time for evaluation shall not entitle the Contractor to an extension of contract time.
 3. There will be no work authorized on site without the prior submittal and subsequent approval of a complete set of shop drawings. Any exceptions to this must be in writing and approved by the Consultant.
 4. Submit as a multi-sheet searchable PDF document with:
 - a. 42" X 30" sheets.
 - b. Table of Contents.
 - c. Bookmarks for every sheet with Sheet Name and Number.
 5. Drawings shall be a standalone package containing all information required for system installation. The package shall include:
 - a. A legend of all symbols and abbreviations used in the drawing package.
 - b. Plan View Drawings showing:
 - 1) Locations of all equipment and devices.
 - 2) Locations of junction boxes, with associated conduits and cable fill.
 - 3) Coordinated layouts of:
 - a) Equipment Rooms.
 - b) Control Booths.
 - c) Production Suites.
 - c. Section and Elevation Drawings including but not limited to:
 - 1) Speakers.
 - 2) Large Displays.
 - 3) Projection Screens.
 - 4) Projectors.
 - 5) LED Display Boards.
 - 6) Monitor Walls.
 - d. Equipment Rack Elevations including:
 - 1) Location of all equipment within the rack.
 - 2) Heat loads for each equipment rack and calculations showing how numbers were derived.
 - e. Custom Furniture and Millwork Details.

- 1) Show all dimensions and finishes for custom furniture and millwork including equipment locations and mounting methods, coordinate with Division 6.
- f. AC Power Requirements.
 - 1) For each equipment rack show:
 - a) Power requirements and calculations showing how numbers were derived.
 - b) Power distribution details within each rack.
- g. Rigging Details.
 - 1) Submit for LED Displays and Speakers.
 - 2) Details will be submitted with licensed engineer stamp licensed to practice at the project location.
 - 3) Drawings will include:
 - a) Structural attachment details.
 - b) Welding calculations.
 - c) Types of hardware to be used.
 - d) Speaker aiming angles.
 - 4) Provide structural calculations along with the stamped drawings. Refer to all requirements of Division 5 – Metals.
- h. Wiring Schematics.
 - 1) Provide complete and detailed wiring schematic for all systems including:
 - a) Cable types.
 - b) Cable identification by number and color codes.
 - c) Detailed wiring of connections to equipment and between equipment racks.
 - d) Equipment identifier matching that used in the Contract Documents.
- i. Schematic drawings of any custom circuitry or equipment modifications, including connector pin-outs and component lists.
- j. Schedules showing:
 - 1) Cable Types.
 - a) Type identifier matching that used in the Contract Documents.
 - b) Manufacturer.
 - c) Part Number.
 - d) Signal Group.
 - e) Nominal Outside Diameter.
 - 2) Junction Boxes.
 - a) Box Name matching that used in the Contract Documents.
 - b) Drawing Reference.
 - c) Location.
 - d) Dimensions.
 - e) Mounting Height.
 - 3) Pull Schedule.
 - a) Pull Length.
 - b) Source and Destination.
 - c) Wire Number.
 - 4) Custom Color and Finishes for:
 - a) Speakers.

- b) Custom Panels.
 - c) Exposed Cabling.
 - d) Custom Furniture.
 - k. Conduit riser diagram showing interconnect of all systems.
 - l. Terminal strip layouts for all terminal strips to be used in junction boxes or equipment racks.
 - m. Connector wiring details including connector model numbers and labeling methodology.
 - n. Network schematic showing:
 - 1) Logical Connections of all devices.
 - 2) IP address scheme.
 - 3) VLAN Scheme.
 - o. Custom Panel Details including:
 - 1) Materials.
 - 2) Finishes.
 - 3) Dimensions.
 - 4) Connector Layout.
 - 5) Connector Labeling.
 - p. Audio, Video and Data patch bay layouts and labeling scheme.
 - q. Mounting and orientation details for:
 - 1) Flat Panel Displays.
 - 2) Surface Mount Speakers.
 - 3) Wireless antennas.
- G. Custom Software Programming including Graphical User Interface (GUI).
- 1. Provide for approval at least 6 weeks prior to system commissioning electronic copies of all custom software. It is the Contractor's responsibility to provide all custom software programming. Coordination with the Consultant is required for the development of this software.
- H. Wireless Frequency Analysis.
- 1. It is the responsibility of the contractor to coordinate all wireless frequencies. The contractor shall perform a spectral sweep from 140 MHz through 3 GHz in the facility and then present a written report of proposed new frequencies.
 - 2. The Contractor must arrange and perform this sweep at a time of day that reflects the time of facility use.
 - 3. The contractor should also include in the report additional frequencies for future expansion.
 - 4. The Contractor will incorporate any existing and other new frequencies in the determination of the new frequencies to be used, including but not limited to wireless intercom, wireless cameras and wireless radios.
- I. Assistive Listening System Analysis.
- 1. Contractor is responsible for providing documentation showing the Assistive Listen system meets accessibility requirements of the project location.
 - 2. Contractor is to provide a quantity of receivers per prevailing code.
- J. Final Inspection Notification Report.
- 1. Two copies of a computer-generated checkout report for the entire system must be prepared and submitted 2 weeks prior to system commissioning. It will include:

- a. A complete listing of every piece of equipment including serial number, the date it was tested and by whom, the results and (if failure occurred during any previous tests) the date retested.
- b. The final report will indicate that every device tested successfully.
- c. A performance test report indicating that the system meets all the Contractor testing requirements in Section 3.7.
- d. A copy of the Final Inspection Report must be included in the Project Manual.

1.10 CONTRACT CLOSEOUT SUBMITTALS

- A. Submit according to conditions of the Construction Contract and Project Manual.
- B. Submit all contract closeout documentation within 30 days after substantial completion, unless otherwise noted.
- C. Contractor shall work off approved shop drawings only. Note changes made during installation on a single set of drawings. This set of marked up drawings will not leave the jobsite until after the final system commissioning. Submit 4 corrected sets of reproducible drawings showing work as installed. All "as-built" drawings to be provided both in electronic form (ACAD 2010 or later) and in hard copy (same size as architectural drawings).
- D. Contractor to provide a Project Manual prior to acceptance testing. Provide a minimum of one hard copy and one electronic copy. This manual shall contain the following information:
 1. Table of Contents.
 2. Contractor's contact information for warranty and/or service.
 3. A complete list of equipment, both installed and loose gear. Include manufacturer, model number, and serial number for all devices. Include settings (software or hardware) for any devices that required modification or adjustment during the acceptance testing.
 4. Operating manuals for each device.
 5. Documentation of all testing results as outlined in Section 3.7.
 6. Wireless microphone frequency coordination report.
 7. A USB drive containing all As-Built drawings in PDF & DWG format.
 8. Replacement parts lists of major items of equipment.
 9. Provide a suggested schedule of routine maintenance. Schedule should include dates of replacement of all batteries, cleaning of air filters and procedures for verifying system functionality.
- E. Create a quick start guide to provide information specific to each room/system, such as procedures for system power on/off, patching, different modes of operation, etc.
 1. The guide should convey information specific to each room/system. It is not intended to be a guide on generic system operation.
 2. Anticipated length of each guide is less than 2 pages front and back.
- F. Software Licensing and Manuals. Provide a copy of all software installed on computers or equipment in the system, including all device configuration files, on a USB disk drive.
- G. Produce compact system flow diagrams showing all components, cables, and wire numbers that will be mounted on the wall of each equipment room. Provide photographically reproducible as-built wiring diagrams at a reduced scale that are easy to handle and fully legible.
- H. Provide a complete list of spares inventory that includes quantity, manufacturer, model number, and serial number.

- I. System Remote Controls. All remotes for displays, projectors, etc. to be collected and turned over to Owner.

1.11 PROJECT CONDITIONS

- A. Verify conditions on the job site applicable to this work. Notify the Consultant and General Contractor in writing of discrepancies, conflicts, or omissions promptly upon discovery.
- B. The drawings diagrammatically show cabling, conduit, wiring, and arrangements of equipment fitting the space available without interference. If conditions exist which make it impossible to install work as shown, recommend solutions and/or submit drawings to the Consultant for approval, showing how the work may be installed.

1.12 WARRANTY

- A. Contractor shall warrant equipment to be free of defects in materials and workmanship for not less than one year after date of Substantial Completion. Defects occurring in labor or materials within the one-year warranty shall be rectified by replacement or repair. Owner furnished equipment is excluded from the warranty, but terminations and wire leading to or from Owner furnished equipment is included. Within the warranty period, provide answer to service calls and requests for information within a 48-hour period, and repair or replace any faulty item within a 72-hour period without charge, including parts and labor.
- B. This warranty shall not void specific warranties issued by manufacturers for greater periods of time. Nor shall it void any rights guaranteed to the Owner by law.
- C. Contractor to provide Owner with exact beginning and ending dates of the warranty period. Include the name and telephone number of the person to call for service. This information is to be part of Project Record Drawings.
- D. Contractor to conduct a final site visit and verify that the system is operational, and all items are functioning correctly at the end of the warranty period. Contractor shall not be responsible for correcting items that have been changed by the Owner or end user.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Model numbers and manufacturers included in this specification are listed as a standard of quality. Equipment and materials will be new, meet the latest published specifications of that product.
- B. All devices will have applicable approvals from a Nationally Recognized Testing Laboratory and meet all applicable local codes and requirements. Should any equipment lack proper approval the Contractor will arrange for onsite inspections and certification at no additional expense to the Owner.
- C. PRODUCT SUBSTITUTIONS.
 1. Consultant will consider other qualified manufacturers subject to review. Submit according to conditions of the Construction Contract and Project Manual.

2. Proposed substitutions must meet all specifications of the specified equipment. The Contractor will supply complete technical data specifications at the time of proposed substitution.
 3. The Contractor will arrange for product demo at the request of the Consultant or Owner Representative and will pay ground freight shipping to and from site, or to and from Consultant's office.
 4. No product substitution will be accepted without the written approval of the Consultant and Owner. The Owner, General Contractor, and the Consultant reserve the right to accept or refuse any substitution without condition.
 5. Upon acceptance of a substitution, Contractor assumes all responsibility for verification and coordination of all heat, power, rack space and architectural requirements.
- D. If product is discontinued and/or no longer publicly advertised as a part of a manufacturer's current product line-up at time of installation, the project team reserves the right to request a substitution of product for new and currently offered product of like function fulfilling the design intent. Substitution value will be based on fair market value of original product at time of bid.

2.2 EQUIPMENT LIST

- A. In addition to the equipment below, include all product specified in Attachment A.
- B. Color selection shown in the equipment list does not designate a selected color. All colors must be coordinated with Architect and Consultant.

2.3 AV SYSTEMS COMPONENTS

- A. AV Equipment Racks:
 1. Rack color: coordinate with Architect.
 2. Verify exact rack space required.
 3. Provide service lamp in the top of each rack.
 - a. Middle Atlantic LT-CABUTL Series
 4. Modular power raceway system. Include as required:
 - a. Middle Atlantic MPR-8A.
 - b. Middle Atlantic MPR-JB####A (Provide size as required).
 - c. Middle Atlantic M-2X20A.
 - d. Middle Atlantic M-30TL-HWA.
 - e. Middle Atlantic power cabling as required.
 5. Provide & install rubber mat under all floor standing racks.
- B. Rackmount UPS Backup.
 1. UPS must have contact closure for remote shut down of load circuits.
 2. UPS to have a minimum 15 min run time under load.
 3. Use fanless UPS in noise control booths and control rooms.
- C. Digital Signal Processor.
 1. See Section 3.2 for Programming Requirements.
 2. Interface DSP logic with fire mute in each rack location.
- D. Network Switches.

1. Contractor to configure switches as required.
 2. Work with related DIV 27 contractors, Owner's IT Provider and other contractors to allocate IP addresses and configure network VLANs to support AV system needs.
 3. All network capable equipment shall be connected to the AV network, including but not limited to Amplifiers, wireless microphones, DSP, playback devices, etc.
- E. Power Amplifiers.
1. Each amplifier to have a 2-ply phenolic label on the front and rear, stating amplifier number and which speakers it is feeding.
- F. Loudspeakers.
1. Coordinate all colors with Architect.
 2. All rigging to allow for +/- 10deg of horizontal and vertical adjustment.
 3. Provide a support structure for speaker systems sized to safely handle the system weight.
- G. FM transmitter with headset receivers for Assistive Listening System.
1. Contractor is responsible for verification of receiver quantities per project code requirements.
 2. Install antenna system in accordance with manufacturer's recommendations.
- H. Wireless Microphone Systems
1. Select wireless frequency bands based upon frequency analysis preformed in Section 1.6.J.
 2. Ensure all modules necessary for a complete system are included.
 3. Ensure all cabling required for remote antenna locations is included.
 4. Contractor shall perform calculations to determine cable and connector loss based on install conditions. Install antenna boosters as required per calculations. Include this report with shop drawing submittals.
- I. Projection Screens
1. Unless otherwise noted on drawings, set limits so the bottom of projected images are 48" above finished floor in classrooms, conference rooms, and meeting rooms and 60" above finished floor in auditoriums and ballrooms. Include additional black drop as needed to meet projected images specified heights. Ensure deployed screens clear all wall protrusions and allow for future installation of wall mounted whiteboard or chalkboard.
- J. Televisions and Mounts
1. TVs must meet the following specifications:
 - a. TV viewable diagonal sizes may be +/- 3" from that specified
 - b. Internal ATSC & QAM tuner
 - c. Internal speakers.
 - 1) TVs will have digital audio output following the selected input.
 - 2) TVs will have an analog audio output following the selected input with variable volume.
 - d. Wall mounted TVs are to be compliant with ADA clearance requirements.
 - 1) If the bottom of the TV is below 6'-8" AFF the following applies:
 - a) Displays 2.5" or less in total thickness to use mounts with a depth of 1.5" or less with micro adjust, tilt & swing arm capabilities.

- b) Displays 2.5" or greater in total thickness to use ultra-thin mounts with a depth of 1" or less with micro adjust & tilt capabilities.
 - c) Display & mounting solution total overall protrusion from the wall not to exceed 4".
 - 2) The total depth of the display & mounting solution not to exceed 4" protrusion from the wall to the front face of the display.
 - 3) The contractor will provide ultra-low-profile mounts per each display to meet all relevant ADA clearance requirements.
 - e. Controllable by 3rd party control system via hardwired RS-232 / serial port.
 - f. LED backlit LCD technology only.
 - g. VESA mount compatible
 - h. Acceptable Manufacturers
 - 1) Sony
 - 2) Samsung
 - 3) LG
 - 4) Panasonic
 - 5) Planar
 - 6) NEC
- K. Audio Patchbays:
- 1. Label each patch point with unique wire label to match label on panel or equipment. Provide functional labels over groups of patch point to label destination hardware or location.
 - 2. Front programmable patchbay
 - a. Bittree B96DC-FNAIT/E3 M2OU12B. (Qty. per design)
 - 3. Patch Cords:
 - a. Coordinate color with owner.
 - b. Bittree BPC1800-110 (Qty. 24 per patchbay provided)
 - c. Bittree BPC2402-110 (Qty. 12 per patchbay provided)
- L. Data Patchbays:
- 1. Data patch point to match specification for cable terminating to patch point. Shielded cabling will require a shielded connector.
 - 2. Label each patch point with unique label to match label on panel or equipment. Provide functional labels over groups of patch point to label destination hardware or location.
 - 3. Modular Patch Panel:
 - a. Install with printed labeling strip.
 - b. Belden AX103114 24-Port 1RU (Qty. per design)
 - c. Belden AX103115 48-Port 2RU (Qty. per design)
 - 4. Cat6 UTP Connector
 - a. Black Keystone
 - b. Belden AX101321 (Qty. per design)
 - 5. Cat6 STP Connector
 - a. Shielded Keystone
 - b. Belden AX104596 (Qty. per design)
 - 6. Provide all patch cables required for use, per system schematics, plus additional 8 matching patch cables per patch bay.

M. Fiber Patchbays:

1. Label each patch point with unique wire label to match label on panel or equipment. Provide functional labels over groups of patch point to label destination hardware or location.
2. Modular Enclosure:
 - a. Belden ECX-01U 1RU LAN Housing (Qty. per design)
 - b. Belden ECX-02U 2RU LAN Housing (Qty. per design)
 - c. Belden ECX-04U 4RU LAN Housing (Qty. per design)
3. Splice Cassettes
 - a. Provide Dual LC Connectors.
 - b. Belden FC3X06LDFS OM3 Aqua Adaptor (Qty. per design)
 - c. Belden FCSX06LDFS SM Blue Adaptor (Qty. per design)
 - d. Belden FCSX06LAFS SM/APC Green Adaptor (Qty. per design)
4. Patch Cables:
 - a. Provide all patch cables required for use, per system schematics, plus additional 4 matching patch cables per splice cassette.
 - b. Belden FP3LDLD002M, OM3 2m
 - c. Belden FPSLDLD002M, OS2 2m
 - d. Belden FPSLALA002M, OS2/APC 2m

N. Video Patchbays:

1. Label each patch point with unique wire label to match label on panel or equipment. Provide functional labels over groups of patch point to label destination hardware or location.
2. Normalled patchbay:
 - a. Bittree B64T-2MWNHD (Quantity Per Design)
 - b. Bittree VPCM 24 02-75 Patch Cords (Qty. 8 per patchbay provided)
 - c. Bittree VPCM 24 05-75 Patch Cords (Qty. 8 per patchbay provided)
 - d. Bittree VPCM 24 06-75 Patch Cords (Qty. 8 per patchbay provided)
 - e. Bittree ADMW48 BNC to Mini-WECO (Qty. 4 per patchbay provided)

2.4 CUSTOM PANELS

- A. Panels to be fabricated by Contractor, engraved and loaded with connectors with information shown on Drawings.
- B. Unless otherwise specified, all wall and ceiling panels will be 1/8-inch-thick, anodized aluminum. (Brush in direction of aluminum grain only.) Engraving will be 1/8-inch block sans serif characters.
 1. Coordinate all panel colors/finishes with Architect.
 2. All custom panels will have beveled edges.
 3. Text color will be white for all black/dark colored panels and black for all white/light colored panels.
 4. Connector color will be silver for all white/light colored panels and black for all black/dark colored panels.
 5. Plastic plates will not be accepted.
 6. Where Extron, Crestron, or other manufacturer's transmission equipment will be mounted on a wall or ceiling plate visible to the public, uses Decora style plates, coordinate color of equipment and wall plate with Architect.
 7. Wall panels sizes to be coordinated with J-boxes dimensions and mounting conditions.

- a. Panels mounted on surface mount boxes will not protrude beyond the edge of the box thereby creating a sharp edge condition.
 - b. Panels mounted on flush mount boxes will extend beyond the edge of the J-box by 1/4" on all sides.
- C. Unless otherwise specified, all rack panels and floor box panels will be 1/8-inch-thick, black anodized aluminum. (Brush in direction of aluminum grain only.) Engraving will be 1/8-inch block sans serif characters. Lettering will be white.
1. Coordinate all panel finishes with Architect.
 2. Connector color will be silver for all white/light colored panels and black for all black panels.
 3. Rack panels will be standard EIA sizes.
 4. Plastic plates will not be accepted.
- D. Floor Boxes will be flush mounted.
- E. Panels in outdoor or harsh environmental conditions will be stainless steel and contain connectors fit for their environment.
- F. Contractor will submit panel engraving schedule and fabrication drawings for approval
- G. Panels to be manufactured by one of the following manufacturers:
1. Panel Authority
 2. Proco
 3. RCI
 4. Whirlwind
- H. Panel Connectors.
1. Panels to contain components listed below:
 - a. Female XLR: Neutrik NC3FD-L-B-1.
 - b. Male XLR: Neutrik NC3MD-L-B-1.
 - c. Locking 1/4": Neutrik NJ3FP6C-B.
 - d. Female XLR-1/4" TRS Combo: Neutrik NCJ6FI-S
 - e. Rugged RJ45: Neutrik NE8FDX-P6-B or NE8FDX-Y6-B
 - f. BNC (75 Ohm): Neutrik NBB75DFIB-P
 - g. BNC (50 Ohm): Canare BJ-JRUD
 - h. 4-Pole Speaker: Neutrik NL4MP
 - i. 8-Pole Speaker: Neutrik NL8MPR-BAG
 - j. Mass Connectors: Whirlwind W-series
 - k. Triax: ADC ProAx Plugs and Jacks w/45 Degree Mount Kit.

2.5 CABLE, CONTROL WIRING & TERMINATIONS

- A. Electrical conductors installed under this contract, except where otherwise specified, will be soft drawn annealed stranded copper having a conductivity of not less than 98% of pure copper.
- B. Refer to drawing AV-001 for scope of work related to supply, installation, and termination of cable.
- C. Refer to drawing AV-001 for cables to be used.
 1. Use plenum and underground cables as required by code.

2. It is assumed all underground cables, where they transition to cable tray or free air, will not pass through plenum spaces outside of conduit.
- D. Refer to drawing AV-001 for minimum cable lengths required outside of boxes.
- E. The Contractor will verify all connector details required for installation of equipment, including make, model, connector sex, attachment configuration, pinouts, and cable clamp accessories.
- F. Video Connectors: All primary video equipment will use crimp-on style BNC connectors. If consumer grade equipment is furnished with RCA connectors, the cable will be terminated in a crimp-on style RCA connector. It will not be acceptable to use BNC to RCA adapters for consumer grade connections.
- G. Video Terminators: Video terminations will be comprised of commercially available 75-ohm 0.1% tolerance units with integral BNC connectors, which are applied as required, plus a 20-count spare.
- H. Speaker Level Rail Mounted Terminal Blocks:
 1. To be used in speaker cluster and Equipment Room junction boxes where shown on schematic drawings or as required by field conditions
 - a. Rail-Mounted Terminal Blocks
 - 1) Positive Terminal (+): Orange Part #2010-1302
 - 2) Negative Terminal (-): Gray Part #2010-1301
 - b. Mount on non-corrosive DIN rail
 - 1) Wago 210-112
 - c. Use insulated Ferrules on all terminations
 - 1) 8 AWG: Wago 216-289
 - 2) 10 AWG: Wago 216-288
 - 3) 12 AGW: Wago 216-287
 - 4) 14 AWG: Wago 216-286
 - d. Crimp with
 - 1) 6-10 AWG: Wago 206-216
 - 2) 12-24 AWG: Wago 206-204
 - e. Use end and intermediate plates
 - 1) Orange: Wago 2010-1392
 - 2) Grey: Wago 2010-1391
 - f. Use push-in jumpers as required
 - 1) Wago 2010-4xx
 - g. Use marking strip system
 - 1) Wago WFB Continuous Marking Strip
 - I. Microphone and Line Rail Mounted Terminal Blocks
 1. To be used in Equipment Room junction boxes where shown on schematic drawings or as required by field conditions
 - a. Rail-Mounted Terminal Blocks
 - 1) Wago 280-550

- b. Mount on non-corrosive DIN rail
 - 1) Wago 210-112
- c. Use insulated Ferrules on all terminations
 - 1) 20 AWG: Wago 216-222
 - 2) 22 AWG: Wago 216-221
 - 3) 24 AGW: Wago 216-321
- d. Crimp with
 - 1) Wago 206-204
- e. Use end and intermediate plates
 - 1) Wago 280-305
- f. Use push-in jumpers as required
 - 1) Wago 280-4xx

J. Cable Mount Connectors.

- 1. Cables to use components listed below, unless otherwise noted:
 - a. Female XLR: Whirlwind WI3F-BK
 - b. Male XLR: Whirlwind WI3M-BK
 - c. Male XLR Numbered: Whirlwind WI3M -BK-#
 - d. To be used on all audio console and stage box inputs.
 - e. 1/4" TS: Switchcraft 280
 - f. 1/4" TRS: Switchcraft 297
 - g. Rugged CAT6 RJ45: Neutrik NE8MX-B-1
 - h. RCA: Canare 75 Ohm
 - i. BNC (75 Ohm): Canare 75 Ohm
 - j. BNC (50 Ohm) Type F Cables: Amphenol Connex 112563
 - k. BNC (50 Ohm) Type G Cables: Amphenol Connex 112120
 - l. 4-Pole Speaker smaller than 12AWG: Neutrik NL4FC
 - m. 4-Pole Speaker greater than 12AWG: Neutrik NLT4FX-BAG
 - n. 8-Pole Speaker smaller than 12AWG: Neutrik NL8FC
 - o. 8-Pole Speaker greater than 12AWG: Neutrik NLT8FX-BAG
 - p. Mass Connectors: Whirlwind W-series
 - q. Triax: ADC ProAx Plugs and Jacks.
 - r. SM Fiber Optic: Amp Metallic ST style (Flat Finish)

K. Use the following chart for color coding cables for use in the AV systems. Please see the drawing package for specific cable part numbers

| Signal Type | Letter | Color |
|--------------------------|--------|-------------|
| HD Video | H | Violet |
| SDI Video | H | Blue, Light |
| Composite Video | H | Green |
| Bi-Level Sync/Reference | H | Red |
| Tri-Level Sync/Reference | H | Orange |
| V-TIE (multi-use) | H | Grey |
| Triax Camera Cable | T | Black |
| Multicore Camera Cable | M | Black |
| Analog Line Level Audio | D | Green |

| | | |
|------------------------|-----|-------------|
| Analog Mic Level Audio | E | Orange |
| Digital Audio (AES) | X | Yellow |
| Time Code | E | White |
| RF (Distributed) | K | White |
| RF (Trunk Line) | L | Black |
| RF Antenna | F/G | Black |
| Tally | E | Chrome |
| RS-232/422/485 Control | R | Chrome |
| Network 10/100/1000 | U | Yellow |
| Network Facility LAN | U | Blue |
| KVM | U | Green, Dark |
| Intercom | E | Brown |
| Speaker | A | Grey |

2.6 J-HOOKS, CABLE HANGER AND TIES

- A. Non-metallic cable support systems such as J-hooks, ties, etc. must be CMP, plenum rated or CMR, riser rated, where applicable. Panduit J-Pro J-hooks Caddy brand "Cable-Cat" hangers or owner and engineer approved equal.
- B. Metallic cable support systems such as J-hooks or Caddy brand "Cable-Cat" hangers must be CMP, plenum rated.
- C. J-hooks will provide a fully radiused support structure with no tight corners to pinch or bind cables, must provide a minimum 1" wide load bearing surface with a minimum 1/4" radius edge.
- D. Cable support system devices will be provided complete with cable retainer.
- E. Cable installation accessories (e.g. pulleys for J-hooks) may be provided and utilized as applicable in compliance with TIA/EIA standards.
- F. "Velcro" type cable wraps will be utilized for cable management only, in the horizontal plane and the vertical plane in MDF, BDF, TR and data cabinets. "Velcro" may not be used in other locations requiring vertical support.
- G. Cable ties of a minimum 0.190" width, installed in a figure 8 pattern around the support member and crossing over the cable/cables will be utilized for cable management and support in a vertical plane.

PART 3 - EXECUTION

3.1 GENERAL

- A. Coordinate work with other trades to avoid causing delays in construction schedule.
- B. Delivery, Storage and Handling.
 - 1. All products and materials to be handled and shipped in accordance with manufacturer's recommendation.

2. Provide protective covering on equipment and furniture during construction to prevent damaging or entrance of foreign matter.
 3. Replace at no expense to Owner, product damaged during delivery, storage, handling or construction.
- C. Mount equipment and enclosures plumb and square. Permanently installed equipment to be firmly and safely held in place.
- D. Cover edges of cable pass-through holes in chassis, racks, boxes, etc., with rubber grommets or Brady GRNY nylon grommetting. Adhesive-backed electrical tape and friction tape is not acceptable for insulating or protective purposes.
- E. Turn over any existing equipment that is not required for the renovation to be salvaged by the AV Contractor and turned over to the Owner.
- F. Mount equipment in racks and consoles and fully wire and test before delivery to job site. If field conditions prevent prior assembly of racks, notify Consultant in writing that racks will be fabricated on site and the reasons for the change.
- G. Provide and install equipment racks as specified under this section in a manner in keeping with local seismic codes. Racks located on concrete floors in equipment rooms or non-finished spaces are to be mount on a 4 inch di-electrically isolated riser such as a 4-inch concrete riser, provided by Division 3. Ensure that all equipment racks are electrically decoupled from flooring to prevent coming into contact with any safety grounded items during operation by providing rubber mat-style isolation between racks and riser.
1. Inspect all racks, consoles, and enclosures prior to installation. All rough or sharp edges that may cause injury to personnel must be deburred or a permanent protective coating applied.
 2. Design and provide ventilation adequate to keep temperature within the rack below 85 degrees Fahrenheit. This ventilation system must be temperature actuated.
 3. Provide blank rack-mount panels installed in all rack openings not occupied by equipment. Blank filler panels will not exceed five rack units in size. Install rack mounted equipment with black 10-32 Phillips head machine screws.
 4. Looking at the rack from the rear, locate AC power, digital control, DC control, and speaker wiring on the left; microphone, line level audio, and video wiring on the right. Panels or equipment mounted on the rear rack rails will not block access to any front mounted components.
 5. Provide security covers on non-user operated equipment having front panel controls. Install covers at the conclusion of Acceptance Testing.
 6. Install rack mounted equipment with black 10-32 button head machine screws.
 7. Panels or equipment mounted on the rear rack rails must not block access to any front mounted components. Front mounted equipment will be given ample space to allow for access to rear connection.
 8. Provide security covers on non-user operated equipment having front panel controls. Install covers at the conclusion of Acceptance Testing.
- H. The process of acceptance testing the System may necessitate moving and adjusting certain component parts - e.g., video monitors.
- I. AC Power and Grounding
1. The Contractor will be responsible for the supply and installation of AC power connections and circuits within the equipment racks that are to be provided under this section. The Contractor is to provide a 6"x6" J-Box at the top of each rack with power circuit cabling terminating in 24" pig tails. The Electrical Contractor will provide all AC

power and conduit to the equipment racks and will terminate AC power circuits within J-Boxes at bottom/top of racks.

2. Install 3-conductor, 120 VAC outlets in each rack. Provide a minimum of two spare outlets in each rack. Label each outlet as to which AC circuit is feeding it and provide the same information in the circuit breaker panel.
3. The A/V system technical ground will be bonded to the metal frame of all equipment racks by use of an uninsulated ground buss lug or bar mounted in each rack. When more than one rack exists, all equipment buss lugs will be bonded to one central equipment rack buss lug. This central equipment rack buss lug will be the only connection to the A/V system technical ground conductor. The ganging of racks together with mechanical fasteners is not an acceptable method of bonding the video system technical ground between racks.

3.2 DSP AND CONTROL SYSTEMS PROGRAMMING

A. General.

1. Programmers will have current manufacturer's certifications for all Control and DSP software.
2. The contractor will develop signal flows and user interfaces for each system. Several levels of user access are expected.
3. All programming is the property of the Owner and will be given to the Owner via flash drive at the end of the system warranty period.
4. All passwords for devices and software will be provided to the Consultant.
5. The Contractor will coordinate with the Owner's IT staff as necessary to interface with the facility LAN and Wi-Fi.
6. Completed programming will be tested and operational prior to system calibration and verification.
7. Three major owners requested revisions to functionality and user interface layouts will be incorporated during the first year of building operation.
8. The lead programmer(s) will be present for 4 Owner designated events to provide event support and functionality verification.

B. Control Systems Programming.

1. Provide control of all AV equipment. Control utilizing a listed method or manufactures documented control process, plugin, or driver utilizing the following protocols:
 - a. TCP/IP
 - b. UDP/IP
 - c. HTTP
 - d. Serial
2. All controlled devices will provide real-time feedback for status and monitoring.
3. Where a listed method of control is not present for an AV component, Contractor will provide a method of control.
4. Custom control programing and scripting is required to control AV equipment.
5. Spaces with user interfaces but without a dedicated processor will use resources from an available processor on the network.

C. DSP Programming.

1. The audio for the systems described above will be processed by a combination of a standalone DSP and onboard amplifier processing. This will provide all equalization, cross-over settings, level control, muting, routing, level monitoring, etc.
2. The audio signal flow through the DSP will be designed so that:
 - a. All processing, from input to output, for a space is on a single tab.

- b. Multiple spaces may share a tab where each space is bordered by a clearly labeled frame.
 - c. A label, meter and mute control for each active input and output are provided on the schematic page.
 - d. Processing signals along a common signal path (input or output processing) is via n-input or multichannel processing blocks. Channel groups should not be used.
 - e. Controls for simple processing blocks, such as delays or high-pass filters, are copied to the schematic page.
 - f. Manufacturer's custom voicing profiles are loaded.
 - g. All controls addressed by scripts, user interfaces, or external control:
 - 1) Are notated by color and naming convention.
 - 2) Have text adjacent to the control noting the associated script or external device. For example:
 - a) "Fire Mute: controlled by GPI 1".
3. When available, the Programmer will utilize the manufacturer's plugins for direct control of equipment, such as amplifiers.
- a. Parameter status in devices will follow status in DSP and vice versa. For example, muting a group of speakers in the amplifier controller software will show the group as muted in DSP. Partial group muting will indicate a partial muting of that group in DSP.
- D. Graphical User Interface Programming.
1. Provide control and monitoring of display devices, playback devices, DSP, and other AV equipment as described below.
 2. User interfaces will be formatted and sized appropriately for display resolutions of the control screen displays. Multiple versions of the same GUI may be required for compatibility with different display resolutions.
 3. Control screen workflow will be activity/preset based and follow these guidelines:
 - a. Activities for each space will be coordinated with the Consultant and Owner.
 - b. User will select an activity, the technical system will configure for the selected activity, and only necessary control elements are available on the user interface.
 - c. Within each activity the control screen will be built around a single page layout with popups displaying control elements as needed.
 - d. When additional control elements are needed, the user will select the advanced operator control page.
 - e. The interface layout will be consistent across all activities with commonly used control items always shown such as source volume with mute.
 4. User interfaces will control technical systems in each space. Each user interface will be tailored for the specific control needs based on the intended user and installed location:
 - a. User control interface will have the following minimum functionality:
 - 1) Control screens:
 - a) Welcome Screen/Login Screen – Coordinate passwords and access levels with Owner.
 - b) Activity Preset Selection Screen – Allows selection of system presets and/or mode of operation and advances to the control screen corresponding to the activity selected.
 - c) Control Screens – For each activity, allow for real-time modification and feedback of routing, source selections, on/off status, muting, monitoring, and level adjustment.
 - 2) Advanced Operator Control Screens:

- a) Overall Status Screen – System power on/off (with off confirmation), signal failover status and reset controls, overall equipment status, fire mute status.
 - b) Support Spaces – Allows source select, monitoring, level adjustment and muting of front and back of house spaces.
 - c) See below for additional advanced functionality.
- 3) The following control buttons will be present on each screen except for the Welcome/Login screen.
- a) Navigation to the activity preset selection screen.
 - b) Power Off (with confirmation) – Turns off all equipment associated with the space and returns to the Welcome/Login screen.
 - c) Logoff – Returns the panel to the Welcome/Login screen without affecting the activity currently in progress. Upon login, the panel should return to the activity's control screen.
 - d) Navigation to the Advanced Operator Control.
- b. Additional Advanced Functionality. Advanced functions or activities will be tailored for the specific control needs based on the intended user and installed location:
- 1) Rooms with Front of House Control Location.
 - a) Metering Screen – Shows primary inputs to the system from mixing console and primary outputs to the space.
 - b) Mute Screen – Allows muting of individual speakers and zones overlaid on a venue map.
 - 2) Rooms with Audio/Video Conferencing.
 - a) Conferencing Screen – Shows feedback of all associated conferencing AV equipment.
 - b) Real-time modification and preview of camera equipment, PTZ controls, VOIP softphone integration, and single button push-to-start meeting automation for conferencing platforms.
 - 3) Rooms with operable partitions.
 - a) Room Combining – Allows multiple rooms to operate as a single room and controls the combining state where routing, source selections, on/off status, muting, monitoring, and level adjustments are made across all combined rooms.
 - b) Logical preset room layouts will be available for selection to place the room into a combined state.
 - 4) Rooms with video walls or LED screens.
 - a) Control and creation of preset video windowing layouts for automation of video display.
 - b) Source selection of each window within each preset video windowing layout.
 - c) Provide pop-up full screen live preview of input sources before adding them to the video display system or associated window.
 - d) Selection of audio source from windowed layout.
 - 5) Rooms that require lighting and window shade controls.
 - a) Provide individual level, color, and zone control of lights and window shade systems.
 - b) Provide control and creation of presets for automation of lights and window shade systems.
- c. Facility wide moments of exclusivity.

- 1) Moments of exclusivity will be coordinated with Consultant and Owner.
- 2) Automate facility wide global control of associated AV equipment to execute specifically defined tasks related to modification of routing, source selections, on/off status, muting, monitoring, and level adjustments.
- 3) Moments of exclusivity will be one of the following:
 - a) Momentary - Automation will be time defined and return the systems to the previous operational state after time has expired.
 - b) Latching – Automation will be deployed as latest takes precedence priority, allowing local controls to override the event after execution.
 - c) Lock-Out – Automation will be deployed as highest takes precedence priority, not allowing local controls to override event.

3.3 CUSTOM CONSOLE AND WORK SURFACE DESIGN

- A. All consoles and casework items will be rigidly constructed and will allow for a minimum temporary additional load of 200 pounds on any horizontal surface without permanent deformation.
- B. Consoles will be steel frame construction using extruded hollow square and angle sections welded together to form the sub-frame. This sub-frame will form the structural support for all equipment loads, work surfaces and writing surfaces.
- C. The steel frame will be electrically arc welded or similar. Remove all spatter and grind off excess weld and burrs. Prepare for shop priming by power wire brushing to remove rust. Degrease, shop prime, and finish with paint finish as specified. Protect for transport and shop/site and apply touch up paint as necessary. All arc weld hardware will be degaussed after the completion of all welding to be done on the piece.
- D. All dimensions and profiles will be checked with all right-angles true and uniform. Use blank rack mount panels to confirm accuracy of mountings.
- E. All attachments to viewable surfaces will be concealed. Attachments through the finish face of painted sections will be countersunk 1/4" below the surface. A resilient packing 1/16" thick will be placed over the screw before the hole is filled with a 2-part epoxy and finish sanded. When fitting panels allow clearances for paint finished. All laminate will be accurately scribed and fitted to the profiles required. Joints will be glued and screwed using frets or glue blocks where possible to ensure rigidity of the panels independently of the steel frame.
- F. Perforated metalwork will be folded accurately to match adjacent profiles with 3/4" returns lapped and spot welded to form a rigid unit. Hinges and accessories will be chrome or brass, including screws.
- G. All consoles will have removable rear panels for rear access to installed equipment. Removable front "kick panel" doors will also be required. All panels will remove completely during installation and service to facilitate installation work. The panels when installed will present a neat and finished appearance and will have a secure mechanical latch mechanism to avoid any rattles or buzzes.
- H. Provide a suitable method of cable access through the bottom and between sections of consoles.
- I. Control interfaces and panels mounted in custom fitted cutouts will provide a non-gaping interface to the surrounding surface to within a 1/32" tolerance.

- J. Clearances: There will be a minimum of 1 inch clearance inside all consoles between the top equipment mounting space and the console top. This is to allow airflow above equipment mounted in the top mounting position. Provide adequate ventilation grilles to allow continuous cooling in consoles containing equipment. This should include both supply and exhaust grilles. Provide ventilation adequate to keep temperature within the rack below 85 degrees Fahrenheit. Provide whisper type ventilation fan in each rack if temperature in rack rises above 85 degrees. This ventilation system must be temperature actuated.
- K. All consoles and racks will have front and rear rack rails separated by at least 24 inches. The rails will be parallel and square and will conform to EIA RS-310C for 19-inch racks.
- L. Console work surfaces will be finished with a material and color selected by the Architect and Owner. Painted and metal panels will be finished with sprayed polyester lacquer, satin finish, and color as selected by the Architect and Owner. Steel frame finish will be black enamel.
- M. Painting:
 - 1. Surface Preparation: Preparation for painting will involve fine paper sanding and dusting to ensure a perfectly smooth substrate.
 - 2. Primer: Sealer undercoat will be spray applied and sanded back using 250 grit. Touch up as needed and re-sand.
 - 3. Finish coats will be spray finished in an appropriate spray booth with approved ventilation, humidity control, dust extraction, and lighting. Finished paint thickness will be 1 mil minimum and will be free from runs, orange peeling, blooming or other blemishes. Metal panels will have a similar finish using appropriate metal primer.

3.4 CABLING

- A. Execute wiring in strict adherence to "standard broadcast practices," as excerpted from "Recommended Wiring Practices," Broadcast Audio Equipment for AM, FM, Television (5th Edition), Radio Corporation of America (RCA), Camden, N.J. 1962, and Appendix II, "Recommended Wiring Practices", Sound System Engineering, (2nd Edition), D. Davis, and performed in accordance with standard professional practice.
- B. Take precautions to prevent and guard against electromagnetic and electrostatic hum. For line level audio signals, float cable shields at the output of source device. Shields not connected to be folded back over cable jacket and covered with heat-shrink tubing. Do not cut off unused shields.
- C. Exercise care in wiring; damaged cables or equipment will not be accepted. Isolate cables of different signals or different levels; and separate, organize, and route to restrict channel crosstalk or feedback oscillation. Keep wiring separated into groups for microphone level circuits, line level circuits, loudspeaker circuits, power circuits, video circuits and control/data circuits.
- D. Route unbroken microphone, audio line, and control wiring from receptacle plate/chassis to patch panel/rack. Remove spliced cables and replace without additional charge to the Owner.
- E. Wiring entering equipment racks will be run directly to equipment. Use of splices or connectors to extend cabling to equipment will not be accepted. All signal wiring will be continuous and unbroken from connector plate/chassis to chassis/patch panel. Use of intermediate connections for inter rack cables is not acceptable. Use of splices or connectors to extend cabling to equipment is not acceptable.

- F. Make joints and connections with rosin-core solder or with mechanical connectors approved by the Owner. Where spade lugs and BNC terminations are used, trim cable using manufacturer recommendations and crimp properly with ratchet type tools. Spade lugs mounted on 22 gauge or smaller cable to be soldered after crimping.
- G. Connect audio cable to active components through screw terminal connections and spade lugs whenever available. Make connections to speaker transformers with properly sized closed end connectors crimped with factory approved ratchet type tool. Wire nut or "Scotchlock" connectors are not acceptable. Do not wrap audio cable splices or connections with adhesive backed tape.
- H. Connect loudspeakers electrically in phase, using the same wire color code for speaker wiring throughout the project.
- I. Wiring and connections will be completely visible and labeled in rack.
- J. All power cables will run on the left side of the equipment rack, as viewed from the rear. All other cables will be run on the right side on the equipment rack, as viewed from the rear. Where signal cabling and any cabling types carrying power must cross, they will do so at right angles. Vertical wiring will be run with a bundling and support system, to maintain a clear and organized appearance.
- K. Horizontally routed wiring to equipment will be neatly tied in manageable bundles with cable lengths cut to minimize excess but still allow ready access for service and testing. Provide horizontal support bars if cable bundles sag
- L. For equipment mounted on slides, additional service loops will be provided to accommodate the full range of travel of the slides. This includes all power, ground, control and signal cables.
- M. Neatly bundle excess AC power cables from rack-mounted equipment with plastic cable ties. Rack wiring to be bundled with plastic cable ties or lacing twine. Electrical tape and adhesive backed cable tie anchors are not acceptable. Cable tie and lacing installation will be accomplished using hand tools specifically designed to apply proper tension to the cable tie, and to cut it off flush with no protruding sharp edges. Cable ties will not be applied with excessive force, which may damage or deform sensitive and fragile cables.
- N. All cables in cable trays will be neatly installed with maintaining separation of the different cable types.
- O. Required production room cable paths and lengths must be predetermined especially in instances where timing is a factor. The information that is essential for the implementation of this task is as follows:
 - 1. Site Survey
 - 2. Floor and Ceiling Plans
 - 3. Elevation Design
 - 4. Equipment List
 - 5. Video and Audio Schematics
 - 6. Cable Trays and Conduits
- P. Multiconductor Cables: Follow a uniform application of color codes for multiconductor cables throughout the Facility. Where there are unused conductors or pairs in a cable assembly, they can be insulated as a group, left long enough for future termination, and folded into the connector hood. Where this is impractical, they may be folded back along the outer jacket of the cable and covered with heat-shrinkable tubing.

- Q. Multipin Connectors: Where jumpers are indicated between pins of the same connector, they will be installed internal to the connector shell and will not have any cable number designations applied to the jumper.

3.5 CABLE HOOKS

- A. Whenever possible, cable and raceway routing paths will follow the logical structure of the building (e.g. follow hallways, aisles and corridors). Route all AV cables and raceways parallel to or perpendicular to the building structure. No diagonal runs will be permitted unless noted otherwise or pre-approved by the Architect and Consultant. Corridor crossovers will be kept to a minimum.
- B. The suspended ceiling and/or lighting fixture support wire or rod will not be utilized to support AV cables. Do not support cables from ductwork, plumbing lines, fire suppression or mechanical systems, etc. Do not lay AV cables on ductwork, piping, plumbing systems or on top of lay-in ceiling tile and lighting fixtures.
- C. Support spacing will not exceed 48". For spans longer than 48", the Contractor shall provide cable tray, channel, ladder, conduit, or other Consultant approved cable support.
- D. A maximum of 17 cables will be supported in a single hanger, no exceptions.
- E. An open ceiling distribution system will not be installed above inaccessible ceiling areas, such as "lock-in" type ceiling tiles, drywall or plaster. Adequate and suitable space will be available in the ceiling area for the distribution system. A minimum of 6" of clear space will be provided on all sides of the distribution system to accommodate installation and servicing.

3.6 LABELING

A. General

1. The attachment method for equipment identification plates will be designed for permanency unless otherwise described. All labels will be protected prior to installation and will not be installed if damaged or scratched. Follow manufacturer's recommended procedure for surface preparation, which must be free of any dust, dirt or film. Wiping with a manufacturer-approved solvent is required. If a label is in a place that might be susceptible to damage, it will be protected with a layer of clear plastic, 1/16" or thicker, taped down. Internal labels will be replaced only if they become illegible. External labels will be replaced if they become scratched or marred.
2. On black lamicooid panels or pushbuttons, letters will be white; on stainless steel or brushed natural aluminum plates, or light-colored pushbuttons, letters will be black.
3. Embossed labels are not acceptable.
4. Mount labels in a neat, plumb and permanent manner except where indicated.
5. Text heights will be as follows:
 - a. Rack designation labels will have 1" high block sans serif text.
 - b. Equipment labels will be 3/4" high block sans serif text.
 - c. Operator Control labels will be 1/4" high block sans serif text, this may be adjusted to fit available space.
 - d. Panel labels will be 1/8" high block sans serif text.
 - e. Patchbay, Cable and Connector labeling will be 10-point block sans serif text, this may be adjusted to fit available space.

B. Equipment Labels

1. Provide engraved lamicoid labels on the front and rear of active equipment mounted in racks. Front mounted equipment labels for the Production Suite video monitor wall monitors are to be mounted with Velcro. Equipment labels to have one line of engraving, giving the schematic reference of the device, and/or its production function, i.e. "VTR #4", "PA-29A".
2. Amplifier labels to include the schematic reference of the device as well as the loudspeaker being fed. Provide color coded labels for the different levels and types of speakers.
3. Unless equipment manufacturer has clearly labeled functions, provide an engraved label over each user-operated control that describes the function or purpose of the control.
4. If the manufacturer provides a protected labeling strip such as those used for switcher control panels and patch bays, then patch/routing point labels may be typed clearly on 80 pound paper stock.

C. Cable Labels

1. Cables and wiring to be logically, legibly and permanently labeled for easy identification. Labels on cables to be adhesive strip type covered with clear heat-shrink tubing. Factory stamped heat shrink tubing may be used in lieu of the adhesive strip style label. Hand-written or self-laminating type labels are not acceptable.
2. Wiring designations to be an alphanumeric code that is unique for each cable. Locate the cable designation at the start and end of each cable run and within 2 inches of the point of termination or connection. For cable runs that have intermediate splice points, the cable will have the same designation throughout with an additional suffix to indicate each segment of the run. Actual cable designation assignments to be determined by Contractor. Add cable designation codes to system schematic drawings included with Project Record Drawings.
3. Provide adhesive labels on the rear of equipment where cables attach to indicate the designation of the cable connected at that point.

3.7 ACCEPTANCE

- A. Provide a pre-commissioning system report to the Consultant two weeks prior to the scheduled systems commissioning proving all systems to be in full compliance. Report will include test results, date of each test, pertinent conditions such as control settings, etc., and test equipment employed. In addition, submit written notification that the installation has been completed in accordance with the requirements of the Contract Documents, and is ready for acceptance testing.
- B. Acceptance testing will include operation of each major system and any other components deemed necessary by the Consultant. Contractor will assist in this testing and provide required test equipment. Contractor will provide at least three technicians familiar with installation, available for the entire testing period (day and night), to assist in tests, adjustments, and final modifications. Tools and material required to make any necessary repairs, corrections, or adjustments will be furnished by the Contractor. The Contractor will keep a running list of all acceptance tests performed and submit a final copy of the results with the closeout submittals as listed in Part 1.6. Testing process is estimated to take 3 days up to 10 hours per day and may require multiple crews / shifts.
- C. During all consultant walkthroughs, the project manager will be present.
- D. If during acceptance testing it becomes evident that further adjustment or work may be required to bring the system into compliance, the Contractor will continue to work until the system is acceptable at no additional charge to the contract price. If approval is delayed because of defective equipment, poor installation, or failure of equipment to meet the requirements of these

specifications, the Contractor will pay for additional time and expenses of the Consultant at the Consultant's standard rate in effect at that time, during any extension of the acceptance testing period. The Contractor will provide rental or loaner equipment to make the system operational in critical cases of equipment failure prior to contract completion.

- E. Verify the following before beginning actual tests and adjustments on the system:
1. Electronic devices are properly grounded.
 2. Powered devices have AC power from the proper circuit and hot, neutral, and ground conductors are connected correctly.
 3. Insulation and shrink tubing are present where required.
 4. Dust, debris, solder, splatter, etc. is removed.
 5. Cable is dressed, routed, and labeled; connections are consistent with regard to polarity.
 6. Clean all control spaces, equipment rooms, production rooms, and equipment racks so they are free from dust, debris, solder, boxes, etc.
 7. Clean air filter for all devices with operable fans (amplifiers, power, supplies, etc.)
- F. Cabling Tests.
1. Submit printed test reports proving the systems to be in full compliance to the consultant as part of the pre-commissioning systems report.
 2. After installation, and before termination, all wiring and cabling will be checked and tested with a megohmmeter to ensure there are no grounds, opens, or shorts on any conductor or shields.
 3. Verify all audio lines are wired to maintain proper continuity and polarity.
 4. Perform TDR measurements on all triax and coax video cables.
 5. Perform sweep tests on all triax and coax cables with a spectrum analyzer. When documenting the results of these tests, include the calculated loss based on length of the video cable measured with the TDR. Correct cabling for any field readings that differ more than 20% from the calculated loss.
 6. Test all CAT5E and CAT6 cables to verify they meet full specifications. Tests will use a certified tester that will confirm bandwidth, cable distance, and error and bit rate detection.
 7. Optical Fiber Cable Testing
 - a. Test all fiber optic cable strands for continuity and performance before and after the cables are pulled and terminated.
 - b. Test link attenuation of all installed multimode fiber optic strands after splicing and termination in accordance with ANSI/TIA/EIA-568-C.1, Section 11.3.
 - 1) One direction with an optical light source and an optical power meter.
 - 2) Test at two wavelengths to account for attenuation differences due to wavelength:
 - 3) 850 nm and 1300 nm for multimode strands.
 - 4) 1310 nm and 1550 nm for singlemode strands.
 - 5) Test multimode strands in accordance with ANSI/EIA/TIA-526-14A, Method B, One Reference Jumper.
 - 6) For multimode strands, wrap reference jumper around mandrel to remove high-order mode transient losses as specified in ANSI/TIA/EIA-568-C.1, Section 11.3.3, Table 11-15.
 - 7) Test Singlemode strands in accordance with ANSI/EIA/TIA-526-7, Method A.1, One Reference Jumper.
 - a) The total attenuation budget for each fiber cable length (end-to-end) will equal the allowed attenuation for the fiber (0.2 dB per km times the length in km) plus the attenuation for each splice and connector. For example, a cable length of 3 km with 1 splice and 2 connectors

would have an attenuation budget of $(3 \text{ km} \times 0.2 \text{ dB/km}) + (2 \times 0.2 \text{ dB}) = 1.2 \text{ dB}$.

- c. Test all installed fiber optic strands after splicing and termination with an OTDR (Optical Time-Domain Reflectometer) per TIA/EIA-455-61:
 - 1) End-to-end bi-directional signature trace with fault finding, connection point reflection, fiber bend, pressure point location, etc.
 - 2) One wavelength, 1300 nm for multimode strands.
 - 3) One wavelength, 1550 nm for singlemode strands.
 - 4) Multimode fiber connector losses $\leq 0.5 \text{ dB}$ at 850 nm
 - 5) Singlemode fiber connector losses $\leq 0.2 \text{ dB}$ at 1310 nm
 - 6) Multimode fiber splice losses $\leq 0.3 \text{ dB}$ at 850 nm
 - 7) Singlemode fiber splice losses $\leq 0.2 \text{ dB}$ at 1310 nm
 - 8) Localized attenuation will not exceed 0.5 dB at any point
 - d. Fibers that are broken or damaged will be replaced at no cost to the owner and replaced fiber optic cables will be re-tested.
 - e. Provide test results in both PDF and in the native file format of the OTDR.
8. Loudspeaker System Tests. Perform the following tests and adjustments. Make corrections necessary to bring system(s) into compliance with the specifications.
- a. Measure and record the impedance of each loudspeaker at the equipment rack with the amplifier disconnected. Measurements will be documented in a table that lists the impedance for each 1/3 octave band over the loudspeakers operating frequency. Measurements will be accurate to within one-tenth of an ohm. As an alternative, contractor may perform, and document full impedance sweeps over each individual device. Sweep to be performed over loudspeakers specified operating range.
 - b. Check polarity of loudspeakers with an electronic polarity checker and by applying music program or constant power per octave (pink noise) signal to system while walking through the transition areas of coverage from one loudspeaker to the next. Transition should be smooth with no apparent shift in source from one speaker to the next.
 - c. Apply sine wave sweep signal to each loudspeaker system, sweeping from 50 Hz to 5k Hz and at a level 10 dB below full amplifier output, and listen for rattles or noise. Correct if apparent.
9. Microphone, line level, and Tie Lines Systems. Confirm the following. Make corrections necessary to bring system(s) into compliance with the specifications.
- a. Proper circuits appearing at each termination location.
 - b. Continuity of all conductors.
 - c. Proper polarity is maintained.
 - d. Absence of shorts between conductors.
 - e. Absence of shorts between conductors and conduit.
- G. System Tests.
1. The following procedures will be performed by the Contractor:
 2. Audio fidelity Verification: Driving an input of the audio system with pink noise and measuring the loudspeaker response from 40 Hz to 16k Hz. Digital Signal Processing will be used to adjust the response of the system (s) to fit the requirements of the space.
 3. Video Signal Verification: From all source inputs (for cameras, character generators, video tape units, etc.) through all VDAs, A/D and D/A converters, processors, switchers, etc., to all signal destinations. Verification of correct signal timing for each source via each path will be made using standard test patterns. Each processing device will be checked; the signal will pass through the device in the no processing mode such that unity luminance, chrominance, and signal timing and phasing conditions are achieved.

- a. Video.
 - 1) Volt (peak to peak) throughout video signal path
 - 2) S/N (peak to RMS), unweighted, DC to 4.2 MHz: 55 dB minimum
 - 3) Crosstalk, unweighted, DC to 4.2 MHz: 45 dB minimum
 - 4) Frequency Response: + 0.5 dB to 4.2 MHz
 - 5) Line and Field Tilt: 2% maximum
 - 6) Differential Gain: 2% maximum
 - 7) Differential Phase: 2 degrees maximum
 - 8) Signal level: within plus or minus 0.5 dB
 - 9) System timing: Sync coincidence within 20 nanoseconds
 - 10) Color timing: Within 1/2 degree at 3.58 MHz
- b. Digital Video.
 - 1) Verify strength of data signal throughout video signal path.
 - 2) Verify validity of data timing signals.
 - 3) Verify receiving device clock recovery
 - 4) Report input data errors
 - 5) Report transport layer errors
4. Control functions will be checked for proper operation, from controlling devices to controlled devices.
5. Adjust, balance, and align equipment for optimum quality and to meet the manufacturer's published specifications. Establish and mark normal settings for each level control, and record these settings, in the "System Operation and Maintenance Manual".
6. Installed and loose equipment will be inventoried for correct Qty.
7. Any other test on any piece of equipment or system deemed appropriate by Consultant.
8. The omission of a description of a device, function, signal path, or test in this document will not exempt the Contractor from responsibility for checking all devices and signal paths for appropriate compliance with Industry Performance Standards and making corrections necessary to bring system(s) into compliance with the applicable standards.
9. The process of acceptance testing the System may necessitate moving and adjusting loudspeaker aiming. Contractor to adjust loudspeaker aiming within parameters set in Part 2. Contractor to make changes without claim for additional payment, this includes the use of lifts, scaffold, etc. If the construction timeline or architecture interferes with the ability to make changes during acceptance testing, notify consultant in writing prior to loudspeakers becoming inaccessible so that final on-site aiming may be accomplished.

3.8 TEST EQUIPMENT

- A. Provide the following equipment on site for final acceptance testing. Test equipment to be available for the entire period through final system acceptance. Prior to start of testing, provide a list to the Consultant of test equipment make and model numbers that will be used.
 1. Multimeter: Measurement range, DC to 20,000 Hz, 100 mV to 300 V, 10 ma to 10A. Acceptable: Fluke 75.
 2. Sound Level Meter: ANSI S1.4-1971 Type S1A with digital or analog display. Meter to provide ranges of 40 to 120 dBA.
 3. Impedance Meter: Capable of testing audio lines at three frequencies, minimum, between 250 Hz and 4k Hz. Measurement Range: 1 ohm to 100k ohms.
 4. Audio Oscillator: bandwidth 20 Hz to 20k Hz +1 dB at 0 dBm output. Output to be balanced. Oscillator to include adjustable output level.
 5. Polarity checker for mic and line level signals.
 6. Polarity checker for loudspeakers.
 7. (2) full height weighted base mic stands
 8. Time Domain Reflectometer.

9. Optical Time Domain Reflectometer: Fluke Optifiber, Corning OV1000, or equal.
10. SDI Generator: Acceptable: Tektronix SDA601
11. SDI Analyzer: Acceptable: Tektronix TSG601
12. Digital Field Strength Meter: Acceptable: Blonder Tongue DFMS-10 or Tektronix RFM90
13. CAT6 cable tester: Acceptable: Microtest Omniscanner 2.
14. Acterna (Formerly Wavetek) SDA-5000 Sweep System
15. Digital Field Strength Meter : Acceptable: Blonder Tongue DFMS-10 or Tektronix RFM90

3.9 INSTRUCTION OF OWNER PERSONNEL

- A. Upon completion of the installation of the specified AV systems, and prior to any facility events, provide designated operating personnel training on the equipment operation. This training will be performed at the site by the Contractor's and the manufacturer's education staff.
- B. The as-built documents and product data submittals must be complete and on-site prior to the time of the first instruction.
- C. For all conference or meeting spaces, provide a single page instruction sheet for setting up a basic presentation and web conference (Team, Zoom, etc.).
- D. First Use. Provide trained personnel (one person) to be present at first three events where the specified systems are in use.
- E. Coordinate schedule of instruction with the Owner subject to availability of Owner's personnel. This may require scheduling instruction during weekends or evenings.
 1. Training will be provided in a series of classes to operations personnel to review all aspects of operation and maintenance of the system.
 2. Follow-up sessions to better enhance the operator's ability to expand or maximize the system will be made available.
- F. The system training will include 5 days or 40 hours of technical training covering the explanation of the system, including documentation, configuration, interfacing and diagnostics. Provide training of the system operators and maintenance personnel as follows:
 1. System Overview: Explanation of system includes documentation, configuration, interfacing and basic diagnosis.
 2. Operator Training General: Basic training in the use of system devices including powering, timing and general operation of overall system.
 3. Operator Training Specific: Advanced training in use of system devices including video on demand and ad insertion equipment.
- G. Where specified, training will be by manufacturer representatives.
 1. Manufacturer training and commissioning is specified in this document.
 2. The Contractor will cover expenses such as flight, hotel, rental car, and meals and include them as part of the bid pricing.

END OF SECTION

SECTION 274134
ATTACHMENT A

| Qty. | Manufacturer | Model Number | Description |
|---------------------------------|-----------------|-----------------|--|
| Auditorium | | | |
| A01 - Infrastructure | | | |
| 1 | Chief Middle | RPMAUS | UNIVERSAL RPMA |
| 1 | Atlantic Middle | UPS-S2200R | UPS STD 2200VA |
| 1 | Atlantic Middle | PD-915RC-20 | PD-915R W/20' POWER CORD |
| 1 | Atlantic Middle | DWR-FK6-32 | 6" FAN32"D DWR FAN KIT |
| 1 | Atlantic Middle | D3LK | 3SP ANOD DRAWER W/LOCK |
| 10 | Atlantic Middle | BL1 | 1SP FLANGED ALUM ANOD BLA |
| 2 | Atlantic Middle | BR1 | 1SP PANEL W/BRUSH GROMMET |
| 1 | Atlantic Middle | U1V | 1SP VENTED UTILITY SHELF |
| 3 | Atlantic Middle | VT1 | 1SP PERFORATED VENT PANEL |
| 1 | Cisco | CON-SW-C9300XM8 | CISCO BASE C9300-48UXM-EDU |
| 1 | Aruba | IAP-315-CI | Access Point |
| 1 | Atlantic Middle | SRSR-4-16 | 4 SLIDE SRSR,16 SPACE |
| 2 | Atlantic Middle | WL-60 | MAGNETIC WORK LIGHT |
| A02 - Loudspeaker System | | | |
| 1 | Misc | Part | Rigging for Sub |
| 1 | QSC | CX-Q 4K8 | 8-Channel 500W/CH Q-SYS Network Amplifier |
| 1 | QSC | CORE 110f-v2 | Unified Core with 24 local audio I/O channels, 128x128 total network I/O channels with 8x8 Software-based Dante license included, USB AV bridging, dual LAN ports, POTS and VoIP telephony, no GPIO, 16 next-generation AEC processors, 1RU. |
| 3 | QSC | TSC-70-G3 | Q-SYS 7-inch PoE Touch Screen Controller for In-Wall Mounting. Color - Black only |
| 1 | QSC | QIO-GP8x8 | Q-SYS peripheral providing control expansion with 8 logic inputs and 8 logic outputs. Up to 4 devices daisy-chainable. 1U-1/4W, powered over Ethernet or +24 VDC. Surface mountable, rack kit sold separately. |

| | | | |
|-----------------------------|-------------------------------------|----------------|---|
| 1 | QSC | QIO-S4 | Q-SYS peripheral providing control expansion with 4 serial communication I/O. Up to 4 devices daisy-chainable. 1U-1/4W, powered over Ethernet or +24 VDC. Surface mountable, rack kit sold separately. |
| 1 | QSC | QIO-ML4i | Q-SYS peripheral providing 4 mic/line inputs. Up to 4 devices daisy-chainable. 1U-1/4W, powered over Ethernet or +24 VDC. Surface mountable, rack kit sold separately. |
| 1 | Tascam | CD-400U | CD/MEDIA PLAYER |
| 1 | QSC | SLDAN-32-P | Q-SYS Software-based Dante 32x32 Channel License, Perpetual |
| 1 | QSC | SLQUD-110-P | Q-SYS Core 110 UCI Deployment Software License, Perpetual. |
| 1 | QSC | SLQSE-110-P | Q-SYS Scripting Engine License |
| 1 | Fulcrum Acoustic | Sub215L | Dual 15 inch Direct-Radiating Subwoofer |
| 6 | Fulcrum Acoustic | GX1595 | 15 inch Coaxial Loudspeaker 90° x 45° |
| 6 | Fulcrum Acoustic | YK-GX15 | GX15 Series Yoke Bracket |
| 5 | Fulcrum Acoustic | RX599 | 5.25 inch Coaxial Loudspeaker |
| 1 | QSC | CX-Q 2K4 | 4-Channel 500W/CH Q-SYS Network Amplifier |
| 1 | Electro-Voice | EVID-S8.2TB | Quick install Speaker 8-inch• cabinet 70/100V black. IP54. Sold only in pairs. |
| 1 | Denon Professional | DN-500CB | CD/USB/1/8" Aux/Bluetooth/Balanced/RS232/Pitch Control Audio Player |
| 1 | Denon Professional | DN300RMKIIX US | SOLID-STATE SD/USB AUDIO RECORDER |
| A03 - FOH Equipment | | | |
| 1 | Yamaha Commercial Audio | DM7 | 28 Motorized faders (12 x 12 x 4); 120 mixable channels; 2 x 12" high-res + 1 high-res 7" multi-touch screens; 48 mono mixes + 12 matrixes + 2 ST bus + 2 cue; 32 x 16 analog I/O; 2 x AES digital I/O; 64 x 64 |
| 1 | HSA Rolltop | INSEXT-II | Inspire Extended Rolltop Desk. Include PLUS4 and INSRKWIDE for additional height and width. Reference drawing #23078 when contacting the manufacturer. |
| A04 - Wireless Mics | | | |
| 1 | Shure | UA844+SWB | Five-way active antenna splitter and power distribution system for QLX-D®, ULX®, ULX-D®, SLX®, and BLX® (BLX4R only) receivers. (470-952 MHz) |
| A05 - Monitor System | | | |
| 4 | Community Professional Loudspeakers | MX10-B | Monitor 2-Way 10-Inch Coax Black |
| 2 | Whirlwind | SK510G12 | Cable - Speaker, NL4 Speakon to NL4 Speakon, 10', 12 AWG, wired 1+ / 1- |

| | | | | |
|----------------------------------|---------------------|--------------------|--|--|
| | JBL | | | |
| 6 | Professional | PRX412M | | 12" Two-Way Stage Monitor |
| 6 | Whirlwind | NL4-050 | | Cable - Speaker, NL4 Speakon to NL4 Speakon, 50', 12 AWG, 4 conductor |
| A06 - Assistive Listening | | | | |
| 32 | Williams AV | BAT 026-2 | | Two (2) 1.2-volt AA rechargeable NiMH batteries. |
| 1 | Williams AV | FM T55 | | FM Plus - Large-area Dual FM and Wi-Fi base transmitter with network control, OLED display, DSP audio processing, analog XLR input and line output. Includes: (1) ANT 025 antenna, (1) TFP 048 power supply, (1) WCA 013 audio cable, (1) WLC 004 line cord. FM operates in the 72-76 MHz band. Replaces PPA T45 / PPA T45 NET |
| 1 | Williams AV | RPK 005 | | Rack panel kit. For one transmitter or modulator in one IEC rack space. |
| 32 | Williams AV | FM R38 | | Multi-channel FM receiver with OLED display. (1) EAR 022 surround earphone, and (1) BAT 001-2 AA alkaline battery. |
| 32 | Williams AV | HED 024 | | Stereo folding headphones. Stereo 3.5 mm plug |
| 8 | Williams AV | NKL 001-S | | Neckloop. 18" cord. 3.5mm stereo plug. For use only with WaveCAST receiver (WF R1). |
| 1 | Williams AV | CHG 3512 PRO | | Multi-bay, drop-in charger with case for 12 FM or infrared body-pack transmitters and/or receivers. Power Supply Included. |
| 1 | Williams AV | IDP 008 | | ADA wall plaque. |
| 1 | Williams AV | ANT 024 | | Dipole wall-mount antenna with F-connector for use with large-area FM transmitters. 75 Ohm. |
| A07 - Loose Inventory | | | | |
| 4 | Shure | SM58-CN BTS | | SM58 + CABLE + STAND BUNDLE |
| 1 | SKB | 1SKB-R3U | | 3U Roto Molded Rack |
| AV02 - Video | | | | |
| 1 | Misc | Part | | Draper 101782 |
| 1 | Epson | V11HA64920 | | EPSON High Brightness EB-PU2116W Projector, 16,000 Lumens, WUXGA, White |
| 1 | Epson | V12H004L08 | | EPSON ELPLL08 Long Throw Lens |
| 2 | Visionary Solutions | DuetE5-WP-BT-BLACK | | A/V Encoder (Wall Plate), 4K60 4:4:4 UHD over IP cinema quality ultra-low latency visually lossless switch matrix routable, with built-in video wall functionality; POE; AES67/Dante, with Bluetooth Audio |
| 2 | Visionary Solutions | DuetE5-WP-BLACK | | A/V Encoder (Wall Plate), 4K60 4:4:4 UHD over IP cinema quality ultra-low latency visually lossless switch matrix routable, with built-in video wall functionality; POE; AES67/Dante |
| 1 | Visionary Solutions | D5200 | | A/V Decoder, 4K60 4:4:4 UHD over IP cinema quality ultra-low latency visually lossless switch matrix routable, with built-in video wall functionality; Expansion Ethernet Port; POE+; Upgradeable to AES67/Dante |

| | | | |
|---|--------|-----------|--|
| 1 | Lumens | VC-A61PNB | (TAA) NDI, 30x Optical Zoom 4K, IP PTZ Video Camera; Black Color |
|---|--------|-----------|--|

Blackbox

A01 - Infrastructure

| | | | |
|---|-----------------|-------------------------|---|
| 4 | Global Truss | QUICK RIG CLAMP BLK | BLK LOW PROFILE QR HOOK CLAMP DT5005B |
| 1 | Middle Atlantic | PD-915RC-20 | PD-915R W/20' POWER CORD |
| 1 | Middle Atlantic | UPS-2200R | 2200VA/1650W UPS |
| 1 | Middle Atlantic | DWR-FK6-32 | 6" FAN32"D DWR FAN KIT |
| 1 | Bittree | B64T-2MWNHD | 2 rows of 32 patch points, 2 RU, fully normalled, non-terminating, 3G SDI |
| 3 | Belden | Data Patchbay - 24 Port | 24 port data patchbay with modular connectors per specifications |
| 1 | Bittree | B96DC-FNSST/E3 M2OU12B | 2 RU, 2x48, Full Normal, Switched Grounds (Sleeve Normalling), E3 Rear Interface, 12" Deep Chassis |
| 4 | Custom | Medium Wall Panel | Custom Wall Panel mounted to pipe boxes with audio, video, & data connectors and cabling to local AV Equipment Rack |
| 1 | Cisco | CON-SW-C9300XM8 | CISCO BASE C9300-48UXM-EDU |
| 1 | Aruba | IAP-315-CI | Access Point |
| 1 | Middle Atlantic | WL-60 | MAGNETIC WORK LIGHT |
| 1 | Middle Atlantic | DWR-18-26 | 18SP/26D WALLRACK BLACK |
| 1 | Middle Atlantic | FD-18 | 18SP SOLID FRONTDR, UNIV. |
| 1 | Grundorf | T8-TLR1224 | Tour 8 Series - Top-Load Rack - 12 Space Top Slant - 12 Space Bottom |
| 1 | Grundorf | TLR8-24-LC2B | Large Caster (4") Two Brakes Dolly Plate |
| 1 | Grundorf | TLR8-24-DM7 | Yamaha DM7C Mixer Top-Load Modification |
| 1 | Grundorf | T8-AR1616 | Tour 8 Series - Amp Rack - 16 Space - 15.56" Rackable Depth |
| 1 | Grundorf | AR8-16-LC2B | Large Caster (4") Two Brakes Dolly Plate |

A02 - Loudspeaker System

| | | | |
|---|--------------------|-------------|--|
| 1 | Radial Engineering | USB-Pro | Digital USB DI for laptops, 24/96 with heapdhone amp & isolated outs |
| 1 | QSC | CORE 8 FLEX | Unified Core with 8 local audio I/O channels, 64x64 network I/O channels with 8x8 Software-based Dante license included, USB AV bridging, dual LAN ports, VoIP telephony, 8x8 GPIO, 8 AEC processors, Half-size 1RU. |
| 1 | QSC | SLQSE-8N-P | Q-SYS Core 8 Flex, Core Nano, NV-32-H (Core Capable). Scripting Engine Software License, Perpetual. |
| 1 | QSC | SLQUD-8N-P | Q-SYS Core 8 Flex, Core Nano, NV-32-H (Core Capable). UCI Deployment Software License, Perpetual. |

| | | | |
|---------------------------------|-------------------------|--------------------------|---|
| 1 | Attero Tech Fulcrum | unD6IO-BT | 4x2 Channel 2 Gang US, Dante/AES67 Wall Plate w/Bluetooth, RCA, 3.5mm I/O, PoE (white and black faceplates included) |
| 4 | Acoustic Fulcrum | CCX896 | 8 inch Coaxial Loudspeaker |
| 4 | Acoustic Fulcrum | YK-CX8 | CX8 Series Yoke Bracket |
| 2 | QSC | CX-Q 2K4 | 4-Channel 500W/CH Q-SYS Network Amplifier |
| A03 - FOH Equipment | | | |
| 1 | Tascam | CD-400U | CD/MEDIA PLAYER |
| 1 | BenQ | PD2700U | Professional,GREY,27",IPS,3840x2160,HDMI/DP/mDP,H DR,Edge to Edge Display,,KVM, Daisy Chain DP Out(MST), Brightness Intelligence, DualView, DarkRoom, Height Adjustable, CAD/CAM Mode, Animation Mode, ZeroFlicker, Low Blue Light |
| 1 | Apple | Mac mini | Owner Furnished Mac Mini or Equivalent. Provide all pertinent software to interface with the system: Dante Controller, Wireless Workbench, Q-SYS Designer, SQ Director, Vision Lite, Mosaic, CCM for HelixNet. Q-Lab licence. |
| 1 | Logitech | Craft Keyboard and Mouse | Owner Furnished Logitech Wireless Keyboard & Mouse or Equivalent. |
| 1 | Tascam | BD-MP4K | 4K UHD BLU-RAY MULTIMEDIA PLAYER |
| 1 | ProX Direct | T-16MRSS13ULT | Universal 19" rackmount mixer 13U Top / 16U Front (3 removable doors) 2 long doors could be use as side tables |
| 1 | Yamaha Commercial Audio | DM7C | 16 Motorized faders (12 x 4); 72 mixable channels; high-res multi-touch 12" + 1 x high-res 7" screens; 48 mono mixes + 12 matrixes + 2 ST bus + 2 cue; 16 x 16 analog I/O; 1 AES digital out; 64 x 64 PY slot I/O; built-in Dante I/O (144 x 144); 18x18 USB-C audio interface; ships with one free license for the following software applications: VST Rack Elements and Nuendo Live. |
| A04 - Wireless Mics | | | |
| 2 | Shure Point Source | UA860SWB | 1/2 Wave Omni Antenna, 2' BNC/BNC Cable, 25' BNC/BNC Cable, WA371 Mounting Clip (470-1100 MHz) |
| 2 | Audio Source | CR-8D-XSH-BL | SERIES8 CARDIOID Headset Microphone for Shure. Color: Black |
| A06 - Assisive Listening | | | |
| 1 | Williams AV | FM T55 | FM Plus - Large-area Dual FM and Wi-Fi base transmitter with network control, OLED display, DSP audio processing, analog XLR input and line output. Includes: (1) ANT 025 antenna, (1) TFP 048 power supply, (1) WCA 013 audio cable, (1) WLC 004 line cord. FM operates in the 72-76 MHz band. Replaces PPA T45 / PPA T45 NET |

| | | | |
|------------------------------|--------------|--------------|--|
| 1 | Williams AV | ANT 024 | Dipole wall-mount antenna with F-connector for use with large-area FM transmitters. 75 Ohm. |
| A07 - Loose Inventory | | | |
| 4 | Renkus-Heinz | CA121-RD | Powered, RHAON & Dante Redundant, SA1250-RD Amp Module |
| 1 | QSC | TSC-710t-G3 | Table top mounting accessory for TSC-70W-G3 and TSC-101W-G3. |
| AV03 - Control | | | |
| 2 | QSC | TSC-70-G3 | Q-SYS 7-inch PoE Touch Screen Controller for In-Wall Mounting. Color - Black only |
| Intercom | | | |
| A09 - Intercom | | | |
| 8 | Clear-Com | KB-701 | Single-Channel flush-mount PTT speaker station: Encore single-channel half-duplex flush-mount push-to-talk speaker/microphone station. Mounts in a four-gang box, console, or accessory enclosure 21.6cm/8.25" x 11.4cm/4.5". |
| 1 | Clear-Com | FSII-BASE-II | FS II Digital wireless base station: FreeSpeak II Digital license-free wireless base station. |
| 4 | Clear-Com | FSII-BP24-X4 | FreeSpeak II Beltpack: 2.4GHz |
| 4 | Clear-Com | CC-28-X4 | Headset: Single ear, Light weight, XLR (F) 4 Pin |
| 1 | Clear-Com | FSII-TCVR-24 | FreeSpeak II Transceiver: 2.4GHz |
| 6 | Clear-Com | HXII-BP-X4 | HelixNet digital 2 Ch. dual listen monaural beltpack: HelixNet digital and IP two-channel dual listen monaural beltpack with a high-contrast OLED display and four-pin male headset connector. It has a three-pin female XLR for Digital PL and an RJ-45 EtherCON PoE intercom line connector. |
| 6 | Clear-Com | CC-110-X4 | LW Single-ear standard HS XLR-4F: Premium lightweight single on ear headset with superior audio quality and on/off switch in gooseneck microphone boom, includes leatherette (fitted) and foam (option) ear pads and headset bag - field removable four-pin female XLR for standard Clear-Com connection. |
| 1 | Clear-Com | HMS-24-UG | HelixNet Main Station Upgrade: 24Ch |
| 1 | Clear-Com | HLI-ET2 | HelixNet Ethernet module: Ethernet interface module. Dual channel Ethernet for LAN connectivity. With the Ethernet Module, Main Stations share partyline channels and program audio and make them available to any station and beltpack on the linked system. This module is required for LAN connected remote stations, wall stations, PoE beltpacks and LQ for port expansion and extended capabilities. Up to 64 IP enabled devices can be connected to the Main Station over the LAN. HLI-ET2 Modules can be mixed with Fiber Modules in the same network. |

| | | | |
|---|-----------|--------|---|
| 1 | Clear-Com | MS-702 | 2 Ch. headset/speaker main station: Encore two-channel headset/speaker main station. Built-in 1-amp (2-amp peak) power supply, 1RU rack mount. Three XLR-3 Male connectors for each partyline A and B, one XLR-3 female for Program Audio in and one XLR-3 Male for Stage Announce out on the rear panel. Jack for hot mic out. |
| 1 | Clear-Com | PS-702 | Encore Power Supply: 2Ch, 1.2 Amp, 1RU with Program Audio |

| Paging | | | |
|--------|----------|-------|---|
| 10 | AtlasIED | AT35D | Deluxe Decora Plate Mounted 35W Attenuator, 3dB Steps |
| 12 | Sonance | 45131 | PS-C63RT WHITE |

END OF ATTACHMENT

SECTION 27 50 00 - SCHOOL COMMUNICATION SYSTEM

PART 1 - GENERAL

1.1 RELATED WORK

The following, in their entirety and as applicable, shall apply to this section. Including any associated drawings.

- A. Conditions of the Contract
- B. Division 1
- C. Division 26
- D. Division 27
- E. Division 28

1.2 SUMMARY

- A. This section includes a fully operational IP platform for a district-wide internal and school Critical Communications Solution, incorporating school safety notifications and general communications including but not limited to the following:
 - 1. The platform shall provide complete internal communications and employ state of the art IP Technology including the minimum functions listed.
 - a. Two-way internal intercommunications between staff locations and classrooms.
 - b. Scheduled bell events.
 - c. Emergency announcements that will override any pre-programmed audio, assuring that all Emergency/Lockdown etc., are heard at each and every speaker location.
 - d. Capability of prerecording emergency announcements that can be activated by a Soft Key on an administrative console, panic button, dial string, or web browser.
 - e. Atomic Time Synchronization with Class Change Tones utilizing multiple, programmable schedules for each zone.
 - f. District-wide, Emergency, Group, All School and Zone live voice paging.
 - g. District-wide, Emergency, Group, All School and Zone paging for pre-recorded audio – tones, music, and voice.
 - h. Web-based user interface.
 - 2. The system shall support a minimum of 1000 level priorities which shall be user-definable, allowing each end point to place a minimum of 5 different priority calls at the same time.
 - 3. Any authorized administrator shall be able to call from outside the school into any classroom, zone, or entire school directly via the School District supplied SIP enabled Telephone Network. This shall allow remote monitoring, call-in annunciation, and two-way conversation from outside the facility as well as paging into the system. (Compliance with NEMA Standard SB-40 for emergency communications in K-12 Schools).
 - 4. Authorized system users shall be able to create a minimum of 100 automated sequences with voice instructions, tones, emails, program distribution, and relay activations and replay them.
 - 5. Automated message strings shall be manually initiated from a single-button access on the console, on a SIP connected telephone, a panic button, from the web-based user interface or via interface with third party systems.
 - 6. Paging and two-way intercom features shall be accessible from any system console or SIP connected telephone for each campus.
 - 7. The platform shall synchronize its system time to the network timeserver or a web-based time server.

8. Each single campus installation shall be locally survivable for intercom, paging, bells, and emergencies such as lockdown, even when the district connection is unavailable.
 9. This specification establishes a minimum level of quality, features, and performance for individual components as well as the integrated system.
 10. Systems that do not comply with the feature-sets highlighted in this Specification will not be considered.
- B. Locate equipment to accommodate millwork, fixtures, marker boards and other room equipment at no additional cost to the Owner.
- C. Integrate the communications system with the following systems:
1. Clock and Bell System
 2. Local sound reinforcement sound systems
- D. Return air plenum cable shall be used. Wherever cabling is run exposed, conduit shall be used to cover and protect wiring.
- E. The drawings and specifications are to be considered conceptual in nature and are intended to establish system standards insofar as manufacturer type and system configuration. The contractor shall provide pricing of a complete engineered system based on the issued conceptual documentation. The engineered system is to be submitted to the project's consultant for review prior to installation.
- F. This system is intended to replace the existing intercom system in its entirety. Contractor shall remove all devices, equipment, and cabling in their entirety.
- G. 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 costliest scenario and obtain clarification during the project.

1.3 DEFINITION OF TERMS

- A. Installer(s): Shall refer to the person, persons, or company who or which actually contracts to perform the work specified herein.

1.4 SUBMITTALS

- A. Product data for each component.
- B. Shop Drawings: Prior to proceeding with the work: Provide detailed equipment assemblies and indicate dimensions, weights, required clearances, method of field assembly, components, location of each field connection, and a complete schedule of all equipment and materials with associated manufacturer's cuts sheets which are to be used.
1. Wiring Diagrams: Detail wiring for power, signal, and control systems and differentiate between manufacturer-installed and field-installed wiring. Identify terminals to facilitate installation, operation, and maintenance. Include a single-line diagram showing cabling interconnection of components and levels throughout system and impedances.
 2. Artwork drawings and lists indicating proposed nameplate nomenclature and arrangements for control panels and plug panels prior to fabrication reflecting equipment used.

3. Each drawing shall have a descriptive title and all sub-parts of each drawing shall be labeled. All drawings shall have the name and locations of the project, Systems Contractor's name in the title block.
 4. Details and descriptions of any other aspect of the system, which must differ from the contract documents due to field conditions or equipment, furnished.
- C. FCC Approval: The system shall be approved for direct interconnection to the telephone utility under Part 68 of FCC rules and regulations. Systems, which are not FCC approved or utilize an intermediary device for connection, will not be considered. Provide the FCC registration number of the system being proposed as part of the submittal process.
- D. Product Certificates: Signed by manufacturers certifying that products furnished comply with specified requirements.
- E. Installer Certificates: Signed by manufacturers certifying that Installers comply with specified requirements.
- F. Manufacturer Certificates: Signed by manufacturers certifying that they comply with specified requirements.
- G. Field Test Reports: Indicate and interpret test results for compliance with performance requirements. Include record of final matching transformer-tap settings, and signal ground-resistance measurement certified by Installer.
- H. Maintenance Data: For equipment to be included in maintenance manuals specified in Division 1.
1. Record of Owners equipment-programming option decisions.
 2. All instructions necessary for proper operation and manufacturer's instructions.
 3. "Proof of Performance" information.
 4. Manufacturer's maintenance information.
 5. Copies of non-proprietary computer programs and system set up disks documenting all programmable features of the installed system.
- I. Record Drawings: Prior to final acceptance, provide three (3) complete sets of drawings indicating all cable numbers and construction details in accordance with the actual system installation. Revise all shop drawings to represent actual installation conditions. These Record Drawings will be used during "Final Acceptance Testing".
- J. System Training: Submit the following information describing the training programs and system trainers as outlined in paragraph 1.6 of this specification and in accordance with Division 1 specifications.
1. Include with the submittal a preliminary staff development training program in outline form for review and approval by the owner's representative.
 2. Include with the submittal a current copy of the trainer's certification from the manufacturer that certifies and identifies the trainer(s) who are eligible to provide training and support for the project.
 3. Include with the submittal a current copy of trainer's needs assessment form which will be reviewed with the owner's designated representative for the system's preliminary system programming and configuration.
 4. Include with the submittal copies of all documentation used to identify for the owner those participants attending and completing the training programs.
- K. A copy of the manufacturer's standard statement of warranty proving all equipment provided for the school communications network is covered with the required five-year warranty shall be included with the project submittal. This statement of warranty shall be

provided on the manufacturer's stationary.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced Installer who is an authorized representative of equipment manufacturer for both installation and maintenance of equipment required for this Section. Provide the following within thirty (30) days after notification to proceed:
1. Provide a list of installations that the Installer has specifically installed for verification by the Owner. Random installations from other vendors and/or Installers shall not be accepted. The Installer, not its employees, must meet these qualifications.
 2. The Installer shall be bondable.
 3. The Installer shall demonstrate to the satisfaction of the Owner or his representative that he has:
 - a. Adequate plant and equipment to pursue the work properly and expeditiously.
 - b. Adequate staff and technical experience to implement the work.
 - c. Suitable financial status to meet the obligations of the work.
 - d. Technically capable and factory trained service personnel at a local service facility to provide routine and emergency service for all products used in this project.
- B. Because the life expectancy of this type of communications structure normally exceeds 10 years, the owner expects continuity from the service provider. If the installing/servicing company has not been an authorized provider of the manufacturer's product for it least seven (7) years, the following is required:
1. A list of two (2) systems manufacturers of which they currently are authorized service providers where the relationship exceeds seven (7) years.
 2. A letter from the manufacturer outlining the details of changes in service providers over the last seven (7) years and what actions they will take to ensure continuity of service to the customer.
- C. Each major component of equipment shall have the manufacturers name, address and model number on a plate securely affixed in a conspicuous place. NEMA code ratings, UL Label, or other data that is die-stamped into the surface of the equipment shall be easily visible.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.
- E. Comply with NFPA 70
- F. Comply with NEMA Standard SB-40 for Emergency Communications in K-12 schools.
- G. Comply with UL 60950.

1.6 SUBMITTALS

- A. Project Initiation:
1. Within fourteen (14) days of Notice to Proceed, the projection system installer shall furnish the following in a single consolidated submittal:
 - a. Product Literature: Complete manufacturer's product literature for all, speakers, amplifiers, cable, 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.
- b. Construction Schedule: A time-scaled Construction Schedule indicating general project deadlines and specific dates relating to the installation of the cable distribution system.
 - c. The contractor shall provide a letter from the manufacturer stating that the dealer is an authorized service center.
 - d. The resume and contact information of the full-time service personnel responsible for the installed projection system.
 - e. Specification Compliance: A letter shall be provided stating, by section and subsection, that the 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) 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.)
 - g. Provide specification with line-by-line acknowledgement of compliance.
- B. Shop Drawings:
- 1. Submit the following items, for Owner review and approval, within twenty-eight (28) days of notice to proceed:
 - a. Proposed wiring and connectivity diagram of the proposed projection system including all faceplates and sound reinforcing equipment
 - b. In addition to the wiring/connectivity diagram, 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 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.

1.7 IN-SERVICE TRAINING

- A. The contractor shall provide and implement a complete and comprehensive staff training program for all administrators, facility staff members, and teachers. This mandatory training program will provide school staff a complete understanding of how to utilize and properly operate all functions.
- B. The training program shall be implemented by a staff member/trainer employed by the contractor. The trainer must be factory certified to provide training on their product.
- C. All staff development training is to be coordinated through the owner's designated representative. As training sessions are completed, the trainer will provide the school's administrative staff and school district's staff a document listing all the staff and faculty members who attended, received, and completed the training program.

1.8 WARRANTY

- A. Provide a manufacturer's five-year warranty of the school communications network equipment against defects in material and workmanship. This warranty will cover all electronic system components. Additional warranties cover clocks, speakers, and call-in switches. If any defects are found within the warranty period, the defective equipment shall be replaced at no cost (equipment only); a one-year warranty shall be provided for labor.
- B. A copy of the manufacturer's standard statement of warranty proving all equipment provided for the school communications network is covered with the required five-year warranty shall be included with the project submittal. This statement of warranty shall be provided on the manufacturer's stationary. The standard five-year warranty is an important element in establishing a standard in quality. Manufacturers who circumvent the five-year warranty by offering special "extended warranties" that are not part of their normal published warranty will not be accepted.
- C. Contractor shall respond, excluding weekends and holidays, within 24 hours to any warranty service calls. If equipment cannot be repaired within 24 hours of service visit, the contractor shall provide "loaner" equipment to the facility at no charge.
- D. Make available a service contract offering continuing factory authorized service of the system after the initial warranty period.

1.9 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide the following system:
 - 1. Telecenter U as manufactured by Rauland and installed by a Rauland authorized dealer

PART 2 - PRODUCTS

2.1 SYSTEM REQUIREMENTS

- A. The New Campus Communications System will connect to the Existing District Server for District Wide announcements and all Management Functions. Server Currently Runs the Rauland Telecenter Campus Enterprise Software.
- B. The platform shall utilize state of the art IP Technology for Call-in Notification, School Safety Paging and Evacuation tones, Atomic Time Synchronization, Class Change Tones

utilizing multiple, programmable schedules for each zone, Two-way hands-free Internal Communications and Paging, and Program Distribution. The system shall be easy to learn and operate. All standard programming shall be web-based and user friendly to allow the system administrator the ability to easily program system features.

- C. Provide complete and satisfactorily operating district/school communications and district/school safety 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 manufacturers' 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.
- D. The platform shall be a single electronic system consisting of a minimum of 10 audio channels for each campus, (classroom) IP Speaker Modules and call switches, IP Zone Modules connecting corridor speakers, inside and outside horns, IP Administrative Consoles, SIP enabled PBX integration and district-wide integration for paging, emergency notifications, calendar scheduling and configuration.
- E. Each Classroom shall be provided with a Speaker Module interface and a minimum of 5 different call switches, each with their own annunciation path and priority.
- F. Call-ins may automatically annunciate (display of priority and location) to administrative consoles, SIP enabled phones, and outside phones.
- G. Call-ins shall be programmed to automatically change priority and annunciation route based on age of call-in and original priority.
- H. Call-ins may have priority (and annunciation route) changed by user action from a console or SIP enabled phone.
- I. Call-in annunciation route shall include playing pre-recorded audio over speakers, sending a pre-configured email, and activating relays.
- J. The platform shall lend itself to expansion by simple addition of hardware modules.
- K. The platform shall connect directly to an existing, standard protocol WAN/LAN network, without the need for a separate server at each school location. Configuration, including bell schedules, calendars, and emergency sequences can be remotely created, changed, stored, and downloaded to the system by an authorized user from a web-based user interface.
- L. The platform shall provide the ability to initiate school safety paging announcements, evacuation tones and take cover tones from any telephone or connected web browser within the facility or outside the facility to any other location within the facility or district.
- M. The platform shall provide the ability to selectively communicate or monitor individual classrooms in emergency situations from any telephone within the facility or outside the facility to any other location within the facility; all communication within the classroom shall be hands-free and will not require any interaction by the classroom user.
- N. The platform shall provide classroom users the ability to confirm that they have safely secured their classrooms during an emergency with a single button press. The front office administrator will receive confirmation that the classroom is safely secured via an administrative console and web-based user interface. The front office administrator can

view classrooms that are not safely secured via the administrative console. The front office administrator can view classrooms that are not safely secured via the web-based user interface. The front office administrator shall be able to initiate two-way communication, without a pre-announcement tone, to the classroom during an emergency via the administrative console. Web-based user interface will still identify that a school is in an emergency, even if all classrooms are safely secured. Individual classroom check-in and school emergency status shall be viewed from the web-based user interface, both on-site and remotely.

- O. IP Addressable and POE powered Speaker Modules for individual rooms shall be system programmable and may be assigned any two, three, four, five- or six-digit number as well as name and description. Any extension may be reassigned at any time.
- P. IP-enabled two-way voice communication shall be available from any provided telephone or administrative console through any speaker in a campus. This shall allow hands-free communication to any classroom or any individual loudspeaker unit. A programmable pre-announce tone shall sound immediately before the intercom path is opened and a supervisory tone shall continue to sound at regular intervals when speaker monitoring is active, complying fully with all privacy legislation. Preannounce tone and supervisory tones shall be disabled during designated emergencies automatically.
- Q. The platform shall allow users to configure multiple schedules per school, with a minimum of 500 unique events per schedule, and automatic Daylight Savings time correction. Schedules can be programmed to occur once, daily, weekly, monthly, or in any combination of the preceding recurrences. Each school may have a minimum of 20 unique bell schedules, with a minimum of 5 active schedules on any given day for each campus. User shall be able to select from 25 standard included tones as well additional user created and uploaded audio files for class change signaling and messaging. In addition, scheduled events shall include relay actions, email notifications, and paging exclusions as system configuration changes. The platform shall allow control of the bell schedules via the district WAN/LAN without the need for a separate server at each school location. Bell schedules can be remotely created, changed, stored, and assigned to calendar days for the local school by an authorized user from a web-based user interface.
- R. The platform shall be able to integrate with an existing PA system or operate as a fully independent IP solution. The platform shall be able to function in combination of said configurations and allow for seamless communication within a school or district-wide, regardless of the type of configuration used. The platform shall be scalable, with the ability to easily add, install, and configure additional equipment to a system.
- S. The platform allows for customization of preprogrammed sequences, used for emergencies, events, and everyday communications. Preprogrammed sequences can be activated from the push of a relay button, soft key of an administrative console, a dial string of a SIP phone, or a web browser configured to the district network. Sequences can be initiated automatically as part of a schedule or on the fly. Preprogrammed sequences can be customized to utilize any combination of audio tones, emails, relays, tone exclusions, swings, delays, duples, SIP phone notifications, and program distribution. Audio tones can include customized audio files and voice messages, recorded in any language. Uploaded audio tones and messages can be preprogrammed to announce repeatedly or individually, as part of a scheduled sequence or on the fly. Each school in a district can have its own customized sequences, and can be activated individually, in groups, or districtwide.
- T. Reference attachment 'A' for more information.

2.2 EQUIPMENT AND MATERIAL

A. Server Software

1. Provides district-wide paging, bell event scheduling, emergency notification and configuration for entire district.
2. Ability to configure system and initiate system features, per school and district-wide via web-based user interface.
3. The software has the ability to sync system time to the Atomic Clock Signal or to the school's or district's network time server.
4. The software will provide a web browser to deliver district-wide emergency paging, pre-recorded messages, and tones from any authorized computer in the facility or the district. The software must be capable of automatically notifying district personnel via the WAN/LAN of an alarm condition.
5. The software can automatically broadcast emergency instructions via associated system hardware throughout an entire district when an alarm (e.g., lockdown, lockout, security, fire) is initiated via the web-based user interface. The emergency instructions are preprogrammed and require no user intervention. Bell tones can be halted during an emergency. The system provides redundant alarm annunciation over intercom/paging speakers and is not meant to replace primary fire alarm or security systems.
6. The software allows for user-uploaded pre-recorded messages and tones. Software supports the upload of MP3 and WAV file types. User-uploaded pre-recorded messages and tones can be part of emergencies, sequences, and bell schedules.
7. The software can be installed in cloud, virtual or physical server environments.
8. The web-based user interface supports secure HTTP browsing.
9. The software supports encryption to ensure secure access.
10. The system shall monitor itself if devices go offline and system actions are not received. Specified users shall receive email notifications when devices go offline. The software shall be able to keep a log and report on system activity within a school or all schools district-wide for a minimum of one year. These reports can be exported to excel spreadsheets.
11. The software will support a minimum of 20 bell schedules per school, with 5 schedules assignable to a specific school day. Bell schedules can be programmed to annunciate tones, activate relays, send emails, activate program distribution, and notify SIP phones.
12. The system allows programmable end points to be automatically included or excluded for live paging, bell tones, or prerecorded audio, depending on the time or day or day of the week. These inclusions/exclusions can be applied manually or automatically depending on their schedule.
13. The software can automatically send an email, as part of a programmed sequence of events, to district administrators alerting them of an emergency within the district.
14. The software provides the ability to view schools that are in an emergency status, using any web browser on the district's network. The software shall identify the name of the school in an emergency as well the type of emergency that school is in.
15. The software provides the ability to view individual classrooms that are not checked-in during an emergency, using any web browser on the district's network. The software shall identify the name, extension, and description of the classroom that is not checked-in during the emergency.
16. The system has a minimum of 5 customizable emergencies, one of them being an All-Clear – with the ability to return the system from an emergency to normal status. Each emergency shall have a minimum of 500 unique events.

17. As a district-wide communications solution, the system shall be able to provide simultaneous communications to all schools or groups of schools within a district. The system shall allow a user to initiate district-wide communications to individual schools, all schools, or groups of schools, from a web-based user interface. The system shall allow a user to initiate prerecorded audio, live paging, or programmed sequences to individual schools, all schools, or groups of schools, from the web-based user interface. Programmed sequences shall be customizable per school, and the system shall be able to activate them simultaneously to individual schools, all schools, or groups of schools, from the web-based user interface.
 18. The communications software must allow upgrade from an individual school system to multiple schools, or an entire school district, using the same web-based user interface. The communications software from an individual school system must be identical in typical user operation to the multiple schools or entire school district communications system software.
- B. Campus Controller
1. Provides call routing for paging and intercom for a single facility.
 2. System shall connect to the district provided Telephone Network via a SIP connection.
 3. Support a flexible numbering plan allowing two, three, four, five, or six-digit extensions.
 4. SIP interface to a district provided Telephone Network shall be capable of allowing connected phones to display classroom call-ins, answer internal intercom call-ins, make pages, and change priorities of call-ins in progress.
 5. Direct dialing, two-way amplified voice intercom between any provided telephone or admin console and speaker without the use of a press-to-talk or talk-listen switch.
 6. Ability to upgrade priority level from individual call switch.
 7. The ability to answer intercom call-ins registered at administrative consoles and pre-selected telephones.
 8. The ability to automatically escalate incoming call-ins to an alternate telephone or group of telephones if they remain unanswered for a predetermined amount of time.
 9. The ability to manually upgrade an intercom call-in to an alternate telephone or group of telephones.
 10. The ability for classrooms to "check-in" via push button when they have successfully secured their location during emergency.
 11. Administrative console shall display locations that have not checked in to confirm their secured location and provide hands-free audio monitoring and communication to unsecured locations.
 12. The controller shall not need direct connection to any classroom via home run or distributed wiring. It shall communicate solely through the IP network.
 13. Single button access from any console on the system to distribute emergency announcements within the facility to all or select locations equipped with speakers. Emergency announcements originating from any assigned administrative console shall have priority over all regular system functions.
 14. Ability for administrative consoles and connected phones to selectively monitor audio at any two-way speaker during an emergency.
 15. Stores a minimum of 48 hours' worth of Bell Event Schedules, all emergency notification sequences as well as facility wide configuration.
 16. System has the ability to sync system time to the Atomic Clock Signal or to the school's or districts network time server.
 17. System's SIP Interface shall provide:
 - a. Audio paging access from any telephone to any single intercom speaker,

- zone (group) of intercom/paging speakers, or all speakers/paging horns throughout the entire facility.
 - b. Ability to answer a call-in directed to that SIP extension.
 - c. Ability to upgrade a call-in directed to that SIP extension.
 - d. Single button access from any telephone on the system to initiate alarm signals within the facility to all or select locations equipped with speakers. A minimum of 25 separate distinct alarm signals shall be provided. Alarm signals originating from any assigned administrative telephone shall have priority over all regular system functions.
 - e. Ability to initiate a school-wide emergency including lockdown and evacuate sequences.
 - f. SIP device shall display call-in information from call in switch. Information will include a minimum of Classroom Name, Number, and Priority Level.
18. The system will have the ability to utilize a web browser and a USB microphone connected to the PC to deliver district-wide live emergency paging, pre-recorded messages, and tones from any authorized computer in the facility or the district. The system must be capable of automatically notifying district personnel via the WAN of an alarm condition.
19. The system can automatically broadcast emergency instructions throughout an entire campus when an alarm (e.g., lockdown, lockout, security, fire) is tripped or manually activated. The emergency instructions are preprogrammed and require no user intervention. Bell tones can be halted during an emergency. The system provides redundant alarm annunciation over intercom/paging speakers and is not meant to replace primary fire alarm or security systems.
- C. IP Addressable Modules:
- 1. System shall provide multiple IP Addressable Modules for intercom, paging and relay activation.
 - a. All Modules are POE 802.3af compliant
 - b. All Modules support DHCP.
 - c. All Modules connect to network with a single RJ45 connector
 - 2. IP Addressable Speaker Module
 - a. Shall interface to school's data network, a classroom speaker, and multiple call switches.
 - b. A minimum of 5 levels of call-in can be placed from an IP Speaker Module. The call-ins are routed to administrative consoles and select SIP connected telephones and can only be cleared from the system once answered. If a call-in is not answered within a preprogrammed time the call-in may reroute to other telephones, consoles, and speakers.
 - c. An option for Privacy call in switches is supported. When the Privacy switch is activated, it prevents administrative or classroom telephones from monitoring the specific classroom/location intercom speaker.
 - d. The ability to belong to one or more of a minimum of 100 independent zones for zone paging, program/music distribution zones and class change tone zones; this assignment is a programmable function, changeable by time of day. Each IP Speaker Module's location shall be programmed in software to belong to any combination of software zones. IP Speaker Modules shall be designed to mount near ceiling and wall speakers and in the plenum space.
 - e. Intercom and paging volume adjustable from Software interface.
 - 3. IP Addressable Zone Paging Module
 - a. Zone Paging Module shall connect multiple speakers for district all page, all page, zone paging, bells, audio events and, emergency notification.
 - b. Zone Paging Modules shall be rack and wall mountable.
 - c. Zone Paging Modules shall be able to belong to one or more of 100

- independent zones for live paging, bells, pre-recorded audio, and emergency notification.
4. IP Addressable Aux I/O Module
 - a. Aux I/O Module shall have two input contacts and two output contacts.
 - b. Input and output contacts are individually addressable.
 - c. Aux I/O Module shall be wall and rack mountable.
 - d. User can program relays to be activated manually, through an event/bell schedule, or during emergency notification.
 - e. Aux I/O Module can perform school lockdown from a single press of a panic button.
 5. IP Addressable Program Line Input Module
 - a. Program Line Input Module shall provide line level audio program distribution into system.
 - b. Program Line Input Module shall have a 3.5mm cable jack.
 - c. Program Line Input Module shall be configured via web-based user interface.
 - d. User can configure program distribution to be activated manually or automatically through an event/bell schedule.
 - e. Program Line Input Module will have a system priority level such that emergency communications override program distribution.
- D. IP Addressable Analog Gateway
1. IP Addressable Gateway provides integration with existing analog wiring infrastructure – consisting of shielded two-pair classroom field wiring. The Gateway provides the ability to reuse speaker wiring, speakers, and punch blocks to integrate analog infrastructure with IP platform.
 2. Each Gateway will have 5 watts of power per port and 25 watts total per device.
 3. Supports 24 classrooms that utilize 25 Volt speakers and all current Telecenter call switches for front office notification.
 4. Supports minimum of 5 call switch priorities per classroom, capable of lockdown check-in functionality, while reusing existing shielded two-pair classroom field wiring.
 5. Classroom intercom volume adjustable from Software interface.
 6. Classroom paging volume adjustable from Software interface.
 7. Configured to the school network and can be used in conjunction with IP Addressable Modules.
- E. IP Addressable Administrative Console
1. A full color screen with 64 soft keys, 3 line select, volume control, push to talk, speakerphone mode and left/right and up/down scrolling.
 2. Audio paging access from any Console to any single intercom speaker, zone (group) of intercom/paging speakers, or all speakers/paging horns throughout the entire school.
 3. Programmable soft key access from any console on the system to initiate alarm signals within the school to all or select locations equipped with speakers. A minimum of 25 separate distinct alarm signals shall be provided. Alarm signals originating from any assigned administrative console shall have priority over all regular system functions.
 4. Programmable soft key access from any console to automatically broadcast page emergency instructions throughout an entire school when an alarm (e.g., lockdown, lockout, security, fire) is tripped or manually activated. The emergency instructions are preprogrammed and require no user intervention. The system provides redundant alarm annunciation over intercom/paging speakers and is not meant to replace primary fire alarm or security systems.
 5. Ability to perform intercom to any single IP Addressable Speaker Module.

6. Ability to display 3 call-ins at a time on the screen while other call-ins are annunciating and the ability to scroll to view all call-ins.
 7. Ability to upgrade a call-in via soft key.
 8. Programmable soft key access from any console for activating relays, campus wide.
 9. Ability to maintain, along with controller and other IP Modules system functions, including intercom, bells and paging for the local campus in the event of district-wide connection loss.
 10. Classrooms that have not 'checked-in' during an emergency are listed on the Administrative Console's screen.
 11. The time duration of an emergency is shown on the screen of the administrative console. The check-in timer is shown on the screen of the administrative console.
- F. Audio Paging/Program Amplifiers – Ashly NE 8250
1. Power amplifier(s) shall be provided to provide a minimum of 2 watts of power to all paging speakers, and 15 watts of power to all paging horns.
 2. The maximum load on the paging/program amplifiers shall be 80% of the rated maximum output of the amplifiers.
- G. Normal/Emergency Call Switch – Rauland Dual Level Call-In Switch
1. Normal/Emergency Call Switches indicated on the drawings shall provide the following functions and features:
 - a. One (1) "Normal" call switch that shall activate a distinctive "NORMAL" level call from single button activation. The button shall be clearly marked "NORMAL" and will route the call-in to any one or more Administrative Consoles and/or Marquee Displays for quick and easy response from an Administrative Console.
 - b. One (1) "Emergency" call switch that shall activate a distinctive "EMERGENCY" level call from single button activation. The button shall be red in color and shall be clearly marked "EMERGENCY" and will route the call-in to any one or more Administrative Consoles and/or Displays for quick and easy response from an Administrative Consoles.
- H. Emergency/Check-In Call Switch – Rauland Check-In Call-In Switch
1. Emergency/Check-In Call Switched indicated on the drawings shall provide the following functions and features:
 - a. One (1) "Emergency" call switch that shall activate a distinctive "EMERGENCY" level call from single button activation. The button shall be red in color and shall be clearly marked "EMERGENCY" and will route the call-in to any one or more Administrative Consoles and/or Displays for quick and easy response from an Administrative Consoles.
 - b. One (1) "CHECK-IN" call switch that shall activate a distinctive "CHECK-IN" level call from single button activation. The button shall be blue in color and shall be clearly marked "CHECK-IN" and will route the call-in to any one or more Administrative Consoles. This button will be used for emergency check-ins during school emergencies, notifying the front office of the classroom occupants' safety during an emergency.
- I. Equipment Racks
1. All equipment racks shall provide 44 spaces (77") minimum for mounted system equipment.
 2. All equipment racks shall be multi-rack format ("gangable") style, bolted together, and open cavity.
 3. All equipment racks will be provided with lockable rear doors.
 4. Equipment rack(s) shall be located in climate-controlled areas/rooms as shown

- on drawings.
 - 5. All head-end, distribution, and source equipment, including data and power, shall be located in racks configured as approved by the Engineer.
 - 6. Rack mounted equipment shall be accessible from front and rear.
 - 7. All unused rack spaces will be covered with appropriate blank/vent panels.
- J. Interior Ceiling Speakers
- 1. Provide Ceiling Speaker Assembly consisting of 8 Ohm, 8" speaker mounted in a 2 foot by 2 foot, lay-in baffle, with an integrated back box that covers the full area of the baffle.
 - 2. The speaker shall be connected by inserting an 8-pin RJ45 terminated CAT 5e or Cat 6 cable.
 - 3. The speaker shall include provisions to allow attachment of a safety cable if required.
- K. Wall Mounted Horns
- 1. Provide double re-entrant type horn loudspeakers with integral driver. The horn loudspeaker shall be impervious to weather and vandalism. Horn shall be constructed of heavy-duty ABS plastic. Horn loudspeaker drivers shall be rated at 15 watts with a frequency response of 480 Hz to 14 KHz. Sensitivity shall be 106 dB 1 watt, 1 meter. Transformer assembly shall be dual voltage multi-tap type suitable for 25 or 70-volt installations. Dispersion pattern shall be 180 degrees conical. The horn loudspeaker shall be constructed of treated heavy gauge aluminum, with all exposed parts potted and a sealed driver. Wiring terminal shall be fully enclosed. The speaker flange and mounting surface shall have a cork-rubber gasket. The horn loudspeakers finish shall be gray baked on enamel.
 - 2. The recessed back box shall be of heavy gauge cold-rolled steel, spot welded for stability with a rust-retardant gray primer finish. Acoustically treat the interior to eliminate mechanical resonance. The back box shall be 10-3/4"x10-3/4"x6" deep.
 - 3. The baffle shall be vandal proof, the faceplate constructed of 14-gauge carbon steel with a minimum tensile strength of 55,000 PSI. A lattice grid sub-plate shall deny access to the horn but be acoustically transparent for sound projection. Provide tamper-proof, stainless steel mounting hardware. The baffle shall have a mar/scratch baked epoxy rust inhibitive finish.
- L. Uninterruptible Power Supplies (UPS)
- 1. UPS equipment provided for this system will include Power Conditioning to smooth current and voltage fluctuations.
 - 2. UPS equipment will be sized in accordance with the system manufacturer's recommendations.
 - 3. Provide an individual UPS for EACH remote gateway outside of the MDF (Gateway) furnished with the system.
 - 4. Provide additional UPS(s) for protection of all other equipment furnished with the system and housed in the equipment racks.
 - 5. All UPS equipment shall be rack mounted.
- M. Wall Mounted Volume Control
- 1. Provide as shown on floor plans. Provide Atlas AT-10PA or approved equal recessed autotransformer volume control. Routine paging shall not override the volume control.
- N. Wall Mounted Emergency Lockdown Button
- 1. Provide Safety Technology International Stopper Station Push, Turn-to-Reset w/shield w/sound, or pre-approved equal in locations as shown on floor plans.
 - 2. Labeled "LOCKDOWN"

3. Lockdown shall be Blue
- O. Program Source Equipment
 1. Provide Qty 1 cd player with blue tooth Interface
 2. Provide 1 Program Source Module to interface with the IP Communications system
 3. Provide a Mixer Preamp for use in adjusting Sound levels
 4. Provide an Interface panel for additional sources and 1 paging Microphone
 5. Provide 1 desk top paging Microphone
 6. Provide Desktop enclosure to house all program source equipment
- P. Additional Equipment:
 1. 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.
 2. Additional Equipment List:
 - a. Five (5) Ceiling Mounted Speakers with tile bridges
 - b. Two (2) Wall Mounted Volume Controls
 - c. One (1) Exterior Speakers

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions, with the Installer present, for compliance with requirements and other conditions affecting the performance of the School Communications and School Safety Network.
- B. Do not proceed until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install system in accordance with NFPA 70 and other applicable codes. Install equipment in accordance with manufacturer's written instructions.
- B. Furnish and install all material, devices, components, and equipment for a complete operational system.
- C. Impedance and Level Matching: Carefully match input and output impedances and signal levels at signal interfaces. Provide matching networks where required.
- D. Control Circuit Wiring: Install control circuits in accordance with NFPA 70 and as indicated. Provide number of conductors as recommended by system manufacturer to provide control functions indicated or specified.
- E. All housings are to be located as indicated.
- F. The contractor shall provide necessary transient protection on the AC power feed, all copper station lines leaving or entering the building, and all central office trunks. All protection shall be as recommended by the equipment supplier and referenced to earth

ground.

- G. Wiring within Enclosures: Provide adequate length of conductors. Bundle, lace, and train the conductors to terminal points with no excess. Provide and use lacing bars.
- H. Provide physical isolation from speaker-microphone, telephone, line-level wiring, and power wiring. Run in separate raceways, or where exposed or in same enclosure, provide 12-inch minimum separation between conductors to speaker-microphones, telephone wiring and adjacent parallel power. Provide physical separation as recommended by equipment manufacturer for other system conductors.
- I. Identification of Conductors and Cables: Use color coding of conductors and apply wire and cable marking tape to designate wires and cables so all media are identified in coordination with system wiring diagrams.
- J. Provide integration of local sound reinforcement system override.
- K. Provide integration of remote lockdown pushbuttons.
- L. Install new speaker types as indicated on the drawings.
- M. Speakers in high ambient noise areas (cafetorium, gymnasiums, etc.) shall be tapped as required to overcome the ambient noise generated by the public.
- N. Provide silicone sealant to all openings and conduit penetrations at all exterior back box locations.
- O. Weatherproofing: Provide weatherproof enclosures for items to be mounted outdoors or exposed to weather.
- P. All exterior wall penetrations shall be properly sealed to prevent moisture from entering the building.
- Q. Conduit and Cables
 - 1. Install conduit, fittings and boxes as specified in Division 26.
 - 2. Single system cables shall be grouped together in a common conduit of adequate capacity to facilitate the ease of installation and prevent conductor or insulation damage.
 - a. In no case shall the conduit fill exceed 40% capacity.
 - b. Do not group conductors or cables of different systems in a common conduit.
 - c. Provide and install protective bushings on all conduit stub outs and sleeves, prior to cable installation, to prevent cable damage.
 - 3. Cable:
 - a. Install cables as recommended by the system manufacturer. Conductor quantities specified are minimum required. Conductors to be installed shall be coordinated with the system equipment supplier.
 - b. Cables installed on exposed surfaces, in inaccessible locations, or underground shall be installed in conduit.
 - c. Cables installed above accessible ceiling spaces may be installed without conduit. All cables not installed in conduit shall be plenum rated.
 - d. Cables shall be routed down corridors, parallel and perpendicular to the building walls and structure. Cable to each device shall branch off a main corridor trunk.
 - e. Routing cables through classrooms, offices, storage rooms, restrooms,

or any type of room other than a corridor will not be accepted. Enter rooms above the associated room doorway.

- f. All cabling shall be home runs to head-end equipment to allow for zoning to be accomplished.
 4. Cables not installed in conduit shall be grouped and bundled. Cable shall be bundled on a maximum of 2'-6" on center. Support cables from D-rings or J-hooks. D-rings and J-hooks shall be secured to the structure at a maximum of 5' on center. Bundling and support shall be with plenum rated cable ties.
 5. Cables installed in hollow wall spaces shall be installed in conduit to an accessible location.
 6. Tag each circuit at each end and at each terminal with a separate tag indicating the area served.
- R. Emergency Lockdown Buttons
1. Cabling for each Emergency Lockdown Button shall be homerun to the Communication System head-end equipment.
 2. Communications system shall communicate with intrusion system over the network when there is a lockdown event.
 3. Provide connection from the Communication System head-end equipment to the Intrusion Detection System head-end for sending notifications to the CFISD Police Department. Coordinate additional requirements and programming with Owner.
 4. Button shall cause the Intercom System to send a distinct alert tone throughout all speakers in the building. Coordinate exact tone with Owner.
 5. Button shall send an Emergency Call signal to all Administrative Call Stations.
 6. Communication System shall alert essential personnel via SMS and e-mail that a Lockdown event has occurred at the campus. Coordinate additional requirements with Owner.
 7. Buttons and alert tone shall be reset by pressing the All-Clear button on any Administrative Call Station console.
 8. Coordinate Emergency Lockdown Button device identification naming with Owner.
 9. Reference attachment 'A' for more information.
- S. Volume Controls
1. Volume Controls shall be configured with emergency call override, allowing emergency announcements to be heard regardless of the position of the volume control.

3.3 ADDITIONAL REQUIREMENTS

- A. Provide visual PA indicator light in deaf education areas and wire into the communications system for bell tones.

3.4 GROUNDING

- A. Provide equipment grounding connections for Integrated Electronic Communications Network systems as indicated. Tighten connections to comply with tightening torques specified in UL Standard 486A to assure permanent and effective grounds.
- B. Racks and cabinets shall be grounded to the metallic structure of the building or to the building system power ground in accordance with NEC section 250. Securely bond equipment to the ground system through a minimum 14-gauge green insulated conductor.

- C. Ground equipment, conductor, and cable shields to eliminate shock hazard and to minimize to the greatest extent possible, ground loops, common mode returns, noise pickup, cross talk, and other impairments. Provide 5-ohm ground at main equipment location. Measure, record, and report ground resistance.
- D. Electronic systems shall be grounded to the building system ground, with a maximum resistance of 0.1 ohm. Systems ground shall be a driven ground rod, building steel, or other approved ground of the building power systems ground.
- E. Provide all necessary transient protection on the AC power feed and on all copper station lines leaving or entering the building. Note in system drawings, the type and location of these protection devices as well as all wiring information.

3.5 FIELD QUALITY CONTROL

- A. **Manufacturer's Field Services:** Provide services of a duly factory authorized service representative for this project location to supervise the field assembly and connection of components and the pre-testing, testing, and adjustment of the system.
- B. **Inspection:** Make observations to verify that units and controls are properly labeled, and interconnecting wires and terminals are identified. Provide a list of final tap settings of paging speaker line matching transformers.
- C. **Testing:** Rectify deficiencies indicated by tests and completely re-test work affected by such deficiencies at Contractor's expense. Verify by the system test that the total system meets the Specifications and complies with applicable standards.

3.6 FINAL ACCEPTANCE TESTING

- A. The Final Acceptance Testing shall be provided to the Owner, or the Owners designated representative only. Final acceptance testing to any other trade or service provider for the project will not comply with the requirements of this section.
- B. The contractor will provide a Final Acceptance Test record document signed by both the contractor and the Owner or designated Owner's Representative establishing the "In Warranty" date. The warranty period will not commence until the Final Acceptance Test is completed.
- C. Be prepared to verify the performance of any portion of the installation by demonstration, listening and viewing test, and instrumented measurements. Make additional adjustments within the scope of work and which are deemed necessary by the Owner because of the acceptance test.

3.7 COMMISSIONING

- A. The contractor shall train the Owner's maintenance personnel in the procedures and schedules involved in operating, troubleshooting, servicing, and preventative maintenance of the system. This training will be in accordance with the training as outlined in Section 1.6 of these specifications. In addition to the Training Materials provided, the contractor will also furnish Operators Manuals and Users Guides at the time of this training.
- B. Schedule training with Owner through the Owner's representative, with at least seven days advance notice.

3.8 OCCUPANCY ADJUSTMENTS

- A. The contractor shall provide Occupancy Adjustments in accordance with Section 1.6 of these specifications. A response scenario amenable to both the owner and the contractor will be established and followed for the first year of service.

3.9 CLEANING AND PROTECTION

- A. Prior to final acceptance, the contractor shall vacuum and clean all system components and protect them from damage and deterioration. All blank spaces in equipment cabinets will be covered with blank panels. Top and side panels, and all cabinet doors will be installed. All general areas within and around all equipment rack/cabinets in the facility will be swept, vacuumed, and cleaned up. No cabinets will be left unlocked, and all cabinet keys will be turned over to the owner or designated owner's representative.

ATTACHMENT 'A'

PROJECT SPECIFIC SCOPE OF WORK AND INSTRUCTIONS

PART 1 – SUMMARY OF WORK – INTERCOM AND CLOCKS

1.1 DESCRIPTION OF WORK

- A. This project consists of the provision and installation of a Intercommunications system as required to support intercommunications, clocks and lockdown buttons. This project is a renovation of Langham Creek HS for Cypress-Fairbanks ISD.
- B. The work includes provision and installation of a complete Intercom System in compliance with these specifications and associated drawings, pre-proposal addenda, change orders, change directives and any other documents issued both pre-proposal and during the project.
- C. It should not be assumed that any portions of a complete and functional system are to be furnished and/or provided by anyone, other than the intercom system installer, unless specifically stated otherwise.
- D. Any network switches that are required shall be provided by the owner. Contractor is responsible for coordinating the switch requirements with the owner so the model of switch from the owners approved manufacture can support the systems needs.
- E. The existing system is to be demolished and replaced. Reference technology floor plans for existing devices that are to remain.

1.2 DESIGN REQUIREMENTS

- A. Provide a complete communications system capable of providing two-way speech communication between selected speaker stations or intercom handsets and main console. System shall also be capable of distributing sound and voice signals to all system speakers simultaneously or in user programmed groups of speaker stations.
 - 1. High School and Middle School classrooms shall have a speaker and a call button. Elementary School classrooms shall have an intercom speaker only. Call button to be Rauland Model #603302.
 - 2. All portable classrooms (A and B sides) shall be updated with IP speakers, Call Buttons and Lock Down buttons. Call Buttons in High Schools and Middle Schools only. Reuse existing call Button and Lock Down Button locations in portables.
 - 3. Reception desk and designated offices shall have Console Phones.
 - 4. All offices shall have a volume control for speakers.
- B. Fire Alarm System Interconnection: APPLICABLE IN HIGH SCHOOLS AND IN MIDDLE SCHOOLS – Main communications and local sound reinforcement systems in the Gymnasiums, Cafeteria, Natatorium, Black Box and Large Group Instruction shall be automatically muted during fire alarm system activation (NFPA Life Safety Code 101, 7-6.3.10 and National Fire Alarm Code 72, 3-8.13.5). However, school communication system shall remain capable of manual override so that school staff can deliver voice instructions over the school communications system, such as directing students to return after a fire drill.

- C. The system shall be supplied by the manufacturer's authorized contractor, Rauland, 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.
- D. 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. 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.
- E. The equipment furnished shall be supplied by one communications contractor. The contractor shall hold the necessary License for this type of work. Contractor is required to submit current certification from manufacturer with submittals.
- F. Provide local wall mounted volume control in all offices, work rooms, conference rooms, teaching theaters, large teaching areas, special needs classrooms, band, orchestra and choir and all practice rooms. Provide volume control at intercom/P.A. rack for auditorium all dressing rooms and corridors around auditorium, cafeteria, and corridor circuits for Middle and High Schools.
- G. Provide call in switch on wall closest to door leading to hallway in Middle and High Schools. Button to be Rauland model #603302. Red EMERGENCY and white NORMAL call in.
- H. Provide IP admin phone and microphone at receptionist, principal's office, AP secretary, all AP's and any admin suite.
- I. ADDITIONS/RENOVATIONS (Existing buildings w/analog recording).
 - 1. Maintain a fully functioning system in unaffected areas.
 - 2. Remove all abandoned equipment and return to owner, remove all abandoned wiring and patch surfaces at wall and floor penetrations.
 - 3. Maintain access to all existing equipment.
 - 4. Prior to construction, a system test will be required of the contractor to demonstrate the current state of the system. Any non-functioning item at this time shall be noted and addressed by CFISD Maintenance. If system is proven to be 100% functional, the contractor is responsible to any repair necessary to return it to its previous state.
 - 5. At Substantial Completion or when system is ready to be tested, a demonstration is required by the contractor to demonstrate the system mirrors the system condition prior to construction. If system is not functioning the same prior to construction, the contractor shall make necessary repairs to bring the system back up to the pre-construction condition.

PART 2 – SUMMARY OF WORK

2.1 INTERCOM SYSTEM – ADDITIONAL INSTRUCTIONS

- A. Manufacturers:

1. Telecenter U IP (new campuses) by Rauland – No Exceptions.
 2. Existing CFISD campuses have Telecenter U. During renovations, IP modules can be added. Confirm with CFISD during design.
- B. Program Source:
1. Use single gang input jack at reception desk. RDL D-J3 Wall mount RCA and XLR Mic/Line Input Panel or equal. Location of this jack may be different for each school, depending on counters and cabinets. Jack shall be mounted near an outlet for power requirements. This replaces CD player, radio, mixer and desktop rack unit. Jack is to be wired and run to head end rack where it connects to Telecenter U Line Input Module. Use copper/analog wiring, not Cat 6 network wiring.
- C. Classroom Speakers for IP System:
1. Rauland TCC2011A IP Module with BAFKIT2X2L8RJ Speaker or equal, to be used in classrooms.
- D. Office and Hallway Speakers:
1. Quam 17URS 2X2 Lay-In Speaker or equal. These offices shall have a volume control.
- E. Bathroom and Hard Ceiling Speakers:
1. Rauland ACC 1400 or equal with backcans.
- F. Wall-mount Surface Speakers - provide flush mount type
- G. Cafeteria and gym intercom speakers should cover entire area; a minimum of six (6) speakers in each gym and nine (9) in each cafeteria. Additional speakers shall be added if required for better coverage.
- H. Exterior Mounting: Flush mount with vandal-resistant metal baffle similar to Atlas / Soundolier Model VP161-APF. Baffle shall be square and designed for flush mounting. Provide backbox designed for flush mounting. Backbox shall be metal with all-welded seams and undercoated to eliminate mechanical resonances. Box shall have rust-resistant coating. Backbox shall be Atlas/Soundolier Model 193 Series deep box for specified speaker and baffle or approved equal. Install gaskets to seal enclosure to speaker. Backboxes and conduit shall be sealed and secured to the building.
- H. SURGE PROTECTOR: Provide over voltage and transient spike surge protector to condition AC voltages into all microprocessed control systems. Tripp Lite IsoBar.
- I. WIRE: Wire shall be #22 gauge at a minimum. Wire for communications system shall consist of (1) twisted pair #22 copper under jacket and one (1) twisted pair #22 under shield copper with overall plenum rated PVC 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. All IP speakers/modules shall be wired by structured cabling contractor. All local low voltage by intercom contractor.
- J. 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.
- K. BACKBOARDS: Provide 4 foot x 8 foot plywood backboards for mounting of system cross connect field. 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 type Series for all cross connect wiring.

- L. CAMPUS CONTROLLER: Integrates with existing District-wide Cisco IP phones. Coordinate with CFISD during design.
- M. HYBRID MODULES: for all 25/70V applications, ie corridors / exterior horns, provide and install 24-port hybrid gateways.
- N. CLOCK SYSTEM
 - 1. At new construction, provide Master Clock Power Supply and Clocks by Sapling. Clocks are to be installed in the following locations only:
 - a. Cafeteria / Commons – 16-inch clock
 - b. Library – 16-inch clock
 - c. Clinic – 12-inch clock
 - d. Gymnasium – Middle Schools and High Schools: 16-inch clock, with protective wire cage; Elementary Schools: LED message board with protective wire cage(no clock).
 - e. Behind receptionist area – 12-inch clock
 - 2. At all renovations, provide Master Clock, Power Supply and Clocks by Sapling. Clocks are to be installed at the following locations:
 - a. Cafeteria / Commons – 16-inch clock
 - b. Library – 16-inch clock
 - c. Clinic – 12-inch clock
 - d. Gymnasium – Middle Schools and High Schools: 16-inch clock, with protective wire cage; Elementary Schools: LED message board with protective wire cage (no clock).
 - e. Behind receptionist area – 12-inch clock
 - f. All other clocks on this system to be removed and patched as required.

2.2 LOCKDOWN BUTTONS – ADDITIONAL INSTRUCTIONS

- A. Lock Down Buttons are to be Make STI and Model SS24A1EM-EN only. (BLUE IN COLOR)
- B. Inside all Main Buildings, wiring for Lock Down Buttons is to be run to the Intercom Head End.
- C. The wire circuit is to be hooked up to the normally open relay on the lock down button and run to a TCC 2024 24 port gateway at the head end. Each gateway input is programmed with the lock down button description.
- D. Additionally, a cable is run from the Intercom headend to the Burglar/Security headend panel to send notification to our Central Station. This allows the Central Station to also be notified in an instance where the school has activated the lock down system.
- E. When the button is activated, the Intercom system sends a distinct tone throughout the building. The tone is the same for all campuses, letting everyone know what they should be doing without having to make an announcement. NOTE: It is not the burglar system sending the tone.

- F. Provide (10) STI model SS24A1EM-EN lock down buttons for each campus in the project.

- G. ACCEPTABLE WIRING METHODS - The District has two acceptable wiring methods for Lock Down Buttons.
 - 1. Inside Main Buildings: Run a home run wire from each Lock Down button to the Intercom Head End. The wire shall be white jacket plenum rated 18 gauge single pair red/black. The wire shall be connected to the Normally Open relay on the Lock Down Button and to a TCC 2024 gateway to trigger a Lock Down. The Module shall be programmed to identify the circuit, zone and button.
 - 2. Inside Portable Buildings: Run a wire circuit to an IP speaker from each Lock Down Button. One wire circuit on the portable A side and one on the B side. The wire shall be plenum rated white jacket 18 gauge single pair red/black. The red/black colored wire is run from the Lock Down Button Normally Open Relay to the IP speaker and terminated on an RJ45 plug (CALRAD Electronics 72-RJ45-T). Each IP speaker module(TCC2011A) has an RJ45 jack on it for AUX inputs. The RJ45 (CALRAD Electronics 72-RJ45-T) is plugged into the Aux Input of the speaker module. The intercom System uses special programming to activate the Lock Down system. (see special programming below).
 - a. Special Programming: Special programming can be created for Lock Down Buttons to work independently or with another call button on the same wire circuit. A 220-ohm resistor is need on the call button when used with a Lock Down Button. This will let the system know which button is being used. Call buttons are only used at High Schools and Middle Schools. Trained technicians will do this programming.

END OF SECTION

**SECTION 28 01 00 - OPERATION AND MAINTENANCE (O&M) MANUALS
OF ELECTRONIC SAFETY AND SECURITY SYSTEMS**

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Compile Electronic Safety and Security (ESS) product data and related information appropriate for Owner's operation and maintenance of products furnished under Contract. Prepare ESS operating and maintenance data as specified in this Section and as referenced in other sections of specifications.
- B. Instruct Owner's personnel in operation and maintenance of equipment and systems.
- C. Submit three (3) electronic copies, on separate devices (CD, USB Flash Drive, or some type of solid-state storage device), of complete O&M manuals in final form. The submitted manual shall be the system manufacturer's operations manual, supplemented with operations and maintenance instructions custom tailored for the system installed. Electronic documentation shall be provided in a non-proprietary PDF format, without password restrictions.
- D. Hard copies shall be provided upon request of the Owner, Architect, and/or Consultant.
- E. Recorded video of all training sessions shall be included in each copy, of each system's final submitted O&M.
- F. The final submitted manual shall include a sign-in sheet and owner/consultant signed acceptance of all training sessions.

1.2 ELECTRICAL OPERATING AND MAINTENANCE MANUAL SUBMITTAL SCHEDULE

- A. Thirty (30) days after receipt of reviewed submittals bearing the Project Technology Consultant's stamp of acceptance (including re-submittals), submit for review, an electronic copy of the first draft of the System's O&M Manual. This copy shall contain as applicable to the specific system, a minimum of the following:
 - 1. Table of Contents for each element
 - 2. Contractor information
 - 3. All shop drawings, coordination drawings and product data, bearing the Project technology Consultant's stamp of acceptance.
 - 4. All parts and maintenance manuals for items of equipment
 - 5. Warranties (without starting dates)
 - 6. Certifications that have been completed; submit forms and outlines of certifications that have not been completed
 - 7. Operating and maintenance procedures.
 - 8. Form of Owner's Training Program Syllabus (including times and dates)
 - 9. Control operations / equipment wiring diagrams
 - 10. Coordination Drawings
 - 11. Schedule of Low Voltage Wire and Cable
 - 12. Schedule of ESS Equipment
 - 13. Schedule of ESS Field Devices
 - 14. Access Control Door Schedules
 - 15. Video Surveillance Camera Schedules
 - 16. Other required operating and maintenance information that are complete.
 - 17. Cable pathway layout drawings and station map, including through wall and floor

penetration locations and sleeve sizes.

- B. Copy will be returned to the Contractor within 15 days with comments for corrections.
- C. Submit the electronic completed manuals (hard copies upon request) in final form to the Project's Technology Consultant.
 - 1. Prior to substantial completion for Owner's use after the Owner accepts facility maintenance.
 - 2. Include all specified data, test reports, drawings, dated warranties, certificates, training videos. along with other materials and information.
- D. The Project's Technology Consultant shall review the manuals for completeness within 15 days.
- E. The Contractor shall be notified of any missing or omitted materials. The Manuals shall be reworked by the Contractor, as required, in the office of the Project's Technology Consultant. The manuals will not be retransmitted.
- F. Electronic and/or hard copies of the accepted manuals shall be delivered to the Owner prior to substantial completion.

PART 2 - PRODUCTS

2.1 BINDERS

- A. Upon the request for hard copies of the O&M manuals, the binders shall consist of the following configuration:
 - 1. Commercial quality black, 3-ring binders with clear, durable, cleanable plastic covers.
 - 2. Minimum ring size: 1"; Maximum ring size: 3".
 - 3. When multiple binders are used, correlate the data into related groupings.
 - 4. Label contents on spine and face of binder with full size insert. Label under plastic cover.

PART 3 - EXECUTION

3.1 SYSTEM OPERATION AND MAINTENANCE MANUAL

- A. Form for Manuals Submitted in Hard Copy Format:
 - 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 flyleaf 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

OPERATION AND MAINTENANCE (O&M) MANUALS OF ELECTRONIC
SAFETY AND SECURITY SYSTEMS

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- 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.
 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 / normal operating instructions
 - 2) Regulation, control, stopping, shut down and emergency instructions
 - 3) 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. Manufacturer's printed operating and maintenance instructions.
 - e. Original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance.
 - 1) Items recommended to be stocked as spare parts.
 - f. Schedule of low voltage wire and cable
 - g. Schedule of ESS equipment
 - h. Schedule of ESS field devices
 - i. Each Contractor's coordination drawings.
 - 1) As installed color coded wiring and cabling diagrams.
 - j. List of original manufacturer's spare parts and recommended quantities to be maintained in storage.
 - k. 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 27.
 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.

END OF SECTION

**SECTION 28 05 00 - ELECTRONIC SAFETY AND SECURITY
BASIC MATERIALS, METHODS, AND GENERAL PROVISIONS**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Except as modified in this Section, General Conditions, Supplementary Conditions, applicable provisions of Division 01 General Requirements, and other provisions and requirements of the Contract Documents apply to work of Division 28 Electronic Safety and Security.
- B. Applicable provisions of this section apply to all sections of Division 28, Electronic Safety and Security.
- C. The general provisions of the Contract and the requirements of the following Sections apply to the Work specified in this Section. See following sections for related general and specific requirements following sections shall associate with this specification as applicable.
 - 1. Division 26 in its entirety.
 - 2. Division 27 in its entirety.
 - 3. Division 28 in its entirety.
- D. The entire drawing and specification package apply to the work specified in the Electronic Safety and Security 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.

1.2 CODES AND STANDARDS

- A. All equipment and work performed shall comply with all of the current and applicable Codes, Rules, Ordinances, Regulations and Standards (including those not specifically listed in this Specification) as interpreted and enforced by the authorities having jurisdiction including:
 - 1. Americans with Disabilities Act (ADA)
 - 2. Authorities Having Jurisdiction (AHJ) - Local
 - 3. American National Standards Institute (ANSI)
 - 4. American Society of Testing and Materials (ASTM) *Communications Cables - B694, B736, D4565, D4566, D4730, D4731, D4732*
 - 5. Building Industry Consulting Services International (BICSI)
 - 6. Code of Federal Regulations - Title 47
 - 7. Electronics Industries Association (EIA) *Standard Test Procedures for Fiber Optic Fibers, Cables, Transducers, Connecting and Terminating Devices - EIA-455 Series*
 - 8. Federal Communications Commission (FCC) - Communications Act and FCC Rules
 - 9. Federal Information Processing Standards (FIPS) *Federal Building Standard for Telecommunications Pathways and Spaces - FIPS PUB 175, FIPS PUB 176*
 - 10. The Insulated Cable Engineers Association (ICEA) *Communications Cable Stands - P-47-434, S-56-434, S-80-576, S84-608, S-85-625, S-86-634, S-87-640, S-89-648, S-90-661, S-98-688, S-99-689, S-100-685*
 - 11. International Electro-technical Commission (IEC)
 - 12. Institute of Electrical and Electronic Engineers (IEEE) *Local Area*

13. *Networks/Metropolitan Networks Standards Collection - LAN/MAN 802 Series International Organization for Standardization (ISO) (ISO/IEC) Premise Wiring Core and LAN/MAN Core Equivalents-11801, 8802, 14763-1*
14. International Telecommunication Union (ITU-T) *Telecommunications Standardization*
15. National Electrical Code (NEC) *National Electrical Code - NFPA 70*
16. National Electrical Contractor's Association (NECA) *Standards of Installation*
17. National Electrical Manufacturers Association (NEMA) *Performance Standard for Twisted Pair Premise Voice and Data Communications Cable-WC 63.1, WC 63.2, WC 66*
18. National Electrical Safety Code (NESC)
19. National Fire Protection Association (NFPA) - *National Fire Alarm Code NFPA 72, Life Safety Code NFPA 101*
20. Society of Cable Telecommunications Engineers (SCTE)
21. Local Accessibility Standards
22. Telecommunications Industries Association (TIA) *(ANSI/TIA/EIA) Wiring and Cabling Standards - 526, 568, 569, 570, 571, 598, 606, 607, 758, TSB 31-B, 63, 67, 72, 75 and 95*
23. Uniform Building Code (UBC)
24. Underwriters Laboratories, Inc. (U.L.) - *497A, 910, 1077, 1863, 1283, 1459, 1604, 1651, 1681, 1690, 1778, 1977*

- B. Resolve any code violations discovered in contract documents with the Engineer prior to award of the contract. After Contract award, any correction or additions necessary for compliance with applicable codes shall be made at no additional cost to the Owner.
- C. This Contractor shall be responsible for being aware of and complying with asbestos NESHAP regulations, as well as all other applicable codes, laws and regulations.
- D. Obtain all permits required.

1.3 SUMMARY

- 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 a new and/or an extension of the existing installation, as shown in the associated specifications and drawings, complete in every respect.
- C. Provide complete and working ESS Systems including equipment, conduit, wiring, material, labor and training as described in this Specification and the Drawings. The ESS Systems Drawings and Specifications are the sole property of the Architect and are not to be duplicated, scanned, loaned or in any way made available to persons not designated as authorized by the Architect. All ESS Systems plans and specifications are to be returned to the Architect following completion of bid.

1.4 CONTRACTOR'S QUALIFICATIONS

- A. An approved contractor for the work under this division shall be:
 1. A specialist in this field and have the personnel, experience, training, and skill, and the organization to provide a practical working system.
 2. Able to furnish evidence of having contracted for and installed not less than ten

- (10) systems of comparable size and type that have served their Owners satisfactorily for not less than 3 years.
3. Perform work by persons qualified to produce workmanship of specified quality. Persons performing work shall be required to be licensed. Onsite supervision shall have minimum of the following:
 - a. Licenses, as applicable to the system being installed
 - b. Manufacturer's Certifications
 - 1) Firm Certification
 - 2) Installer Certification
 - 3) Programmer's Certification
 - 4) System Designer Certification.

1.5 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 Consultant for review. No departures shall be made without prior written acceptance of the Consultant.
- 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 Consultant in writing, shall be performed or furnished. In the case that 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. The approximate locations of system equipment and components are indicated on the Drawings. These Drawings are not intended to give complete and accurate details in regard to location of equipment, field devices, etc. Exact locations are to be determined by actual measurements at the building and will in all cases be subject to the Review of the Owner or Consultant, who reserves the right to make any reasonable changes in the locations indicated without additional cost to the Owner.
- E. Items specifically mentioned in the Specifications but not shown on the Drawings and/or items shown on 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.
- F. Any discrepancies between the Contract Documents and actual job site conditions shall be reported to the Owner or Consultant, so that they will be resolved prior to the bidding, where this cannot be done at least 7 working days prior to bid; the greater or costlier of the discrepancy shall be bid. All labor and materials required to perform the work described shall be included as part of this Contract.
- G. It is the intention of this Section of the Specifications, and associated drawings, to outline minimum requirements to furnish the Owner with a turnkey and fully operating system in cooperation with other trades.
- H. The contract documents are schematic in nature in that they are only to establish scope and a minimum level of quality. They are not to be used as actual working construction drawings. The actual working construction drawings shall be the shop drawings accepted

by project's consultant.

- I. 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 project's consultant 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.
- J. These documents are conceptual in nature. It shall be the responsibility of the approved installer to furnish a complete and functional system, including the items shown on the drawings, in the specifications, and items not designated in either. The installer's shop drawings and product data submittals shall represent a complete system and documents accepted by the project's consultant shall not relieve the installer from being required to provide any materials, equipment, or labor to furnish a complete and functional system as recognized by the Project's Technology Consultant and the Owner.

1.6 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, ordinances, and standards; 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 closed ceiling space and/or furred chases unless specifically noted or indicated to be exposed. Work shall be installed to avoid crippling of structural members. 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 Consultant. The Consultant 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.
- E. Consider space limitations imposed by contiguous work in selection and location of equipment and material. Do not provide equipment or material that is not suitable in this respect.

1.7 RELATION WITH OTHER TRADES

- A. Carefully study all matters and conditions concerning the project. Submit notification of conflict in ample time to prevent unwarranted changes in any work. Review other Divisions of these specifications to determine their requirements. Extend electrical

services and final connections to all items requiring same.

- B. Because of the complicated relationship of this work to the total project, conscientiously study the relation and cooperate as necessary to accomplish the full intent of the documents.
- C. Where cabling pass through walls or floors, metal sleeves shall be provided and shall be sealed to prevent spread of fire and smoke. In walls, they shall extend 3" beyond the finished surface. In pipe chases, they shall extend 8" inches above floor slab and be cemented in a watertight manner. Size of these sleeves shall be at least as required to maintain a maximum 40% conduit fill ratio. 1/2 inch greater than outside diameter of the conduit.
- D. Locate and size openings required for installation of work specified in this Division in sufficient time to prevent delay in the work.
- E. Refer to other Divisions of the specifications for the scope of required connections to equipment furnished under other Division. Determine from the General Contractor / Construction Manager for the various trades, the Owner, and by direction from the Architect / Engineer, the exact location of all items. The construction trades involved shall furnish all roughing-in drawings and wiring diagrams required for proper installation of the electrical work.
 - 1. Make final connections to all ESS equipment indicated on the drawings, except as noted.
- F. Request all Shop Drawings required in ample time to permit proper installation of all electrical provisions.
- G. Extend services as indicated to the various items of equipment furnished by others. Rough-in for the various items and make final connections ready for operation upon placing of the equipment.

1.8 CONCEALED AND EXPOSED WORK

- A. When the word "concealed" is defined as hidden from sight as in chases, furred spaces or above ceilings. "Exposed" is defined as open to view, in plain sight.

1.9 GUARANTEE

- A. Guarantee work for a minimum of two years or as noted longer elsewhere from the date of substantial completion of the project. During that period make good any faults or imperfections that may arise due to defects or omissions in material, equipment or workmanship. At the Owner's option, replacement of failed parts or equipment shall be provided.

1.10 MATERIAL AND EQUIPMENT

- A. Furnish new and unused materials and equipment meeting the requirements of the paragraph specifying acceptable manufacturers. Where two or more units of the same type or class of equipment are required, provide units of a single manufacturer.

1.11 NOISE AND VIBRATION

- A. Select equipment to operate with minimum noise and vibration. If noise or vibration is

produced or transmitted to or through the building structure by equipment, piping, ducts or other parts of work, and judged objectionable by the Owner, Architect, or Engineer, rectify such conditions at no additional cost to the Owner. If the item of equipment is judged to produce objectionable noise or vibration, demonstrate at no additional cost that equipment performs within designated limits on a vibration chart.

1.12 ACCEPTABLE MANUFACTURERS

- A. Manufacturers names and catalog number specified under sections of Division 28 are used to establish standards of design, performance, quality and serviceability and not to limit competition. Equipment of similar design, equal to that specified, manufactured by a named manufacturer shall be acceptable on approval. A request for prior approval of equipment not listed must be submitted ten (10) days before proposal due date. Submit complete design and performance data to the Architect. The Architect and Owner issue approvals of acceptable manufacturers as addenda to the Construction Proposal Documents.
- 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.

1.13 UTILITIES, LOCATIONS AND ELEVATIONS

- A. Locations and elevations of the various utilities included within the scope of this work:
 - 1. Obtained from utility maps and other substantially reliable sources.
 - 2. Are offered separate from the Contract Documents as a general guide only without guarantees to accuracy.
- B. Examine the site and verify the location and elevation of all utilities and of their relation to the work. Existing utilities indicated on the site plans are for reference only and shall be field verified by the Contractor with the respective public or private utility.

1.14 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.
- B. It is the responsibility of the Contractor to compare the scale of all electrical drawings with the scale of the architectural drawings and make adjustments to all electrical drawings which have the incorrect drawing scale so that his material takeoffs are not in error due to an incorrectly labeled drawing scale and his proposal is complete.

1.15 ABBREVIATIONS AND DEFINITIONS

Abbreviations:

| | |
|-----|------------------------------|
| A/V | Audio/Visual |
| AWG | American Wire Gauge |
| BCR | Building Communications Room |
| CMP | Communications Media Plenum |
| CMR | Communications Media Riser |
| dB | Decibel |

| | |
|------|---|
| EMI | Electromagnetic Interference |
| ER | Equipment Room |
| ESS | Electronic Safety and Security |
| FACP | Fire Alarm Control Panel |
| FCR | Floor Communications Room |
| Hz | Hertz |
| IDF | Intermediate Distribution Frame |
| Km | Kilometer |
| LCD | Liquid Crystal Display |
| LED | Light Emitting Diode |
| M | Micron |
| MDF | Main Distribution Frame |
| MHz | Megahertz |
| NEXT | Near-End Cross Talk |
| nm | Nano-meter |
| OFN | Optical Fiber Non-conductive |
| OFNP | Optical Fiber Non-conductive Plenum |
| OFNR | Optical Fiber Non-conductive Riser |
| OTDR | Optical Time Domain Reflectometer |
| TC | Telecommunications Closet (<i>Now referred to as TR</i>) |
| TR | Telecommunications Room (<i>A.K.A. TC - Telecommunication Closet</i>) |
| UTP | Unshielded Twisted Pair Wire |

Definitions:

Low Voltage Wire - Wire or cable used for one or more systems that operate on 24 volts or less. Low Voltage Wire is used to install and interconnect one or more of the ESS Systems. Low Voltage Wire includes patch cords, jumpers and all portions of cable or wire used to make the ESS Systems operational or for system communications.

Electronic Safety and Security Systems - One or more of the following and associated equipment: Fire Detection/Alarm Systems, Intrusion Detection/Alarm Systems, Access Control Systems, Video Surveillance Systems,

1.16 QUALITY ASSURANCE

A. Equipment Standards:

1. System and all components shall be brand new stock from manufacturer.
2. All electronics shall be 100% solid state.
3. System and all components shall bear a UL Label.

B. Contractor Qualifications:

At the time of Proposal, the Contractor shall:

1. Have manufactured, supplied or installed at least three (3) other systems of similar size, complexity, and general operation as the systems described in these specifications. The Contractor shall furnish in writing to Architect proof of compliance with this paragraph at the time of proposal.
2. Hold all legally required Texas State Contractor's licenses necessary to accomplish the installation and activation of the described system at the facilities indicated. The Contractor shall submit copies of licenses to the Architect prior to the start of work
3. Hold all legally required state registrations to meet local requirements for submittal drawings.

4. Have a local office within fifty (50) miles of the project site staffed with factory trained technicians who have experience on systems of similar complexity and function as the systems described in these specifications. These technicians shall be fully capable of system engineering support, installation supervising, system start-up, and providing the Owner with training and service on both hardware and software for the systems specified.
5. Certify complete and total compliance with the provisions of these specifications by letter or submittal of the proposal response forms, signed by an officer of the corporation, or a principal if other ownership currently exists. In addition, the letter or forms shall include a complete listing of exceptions, if any.

1.17 SUBMITTALS

- A. Provide SUBMITTALS according to Division 1 and the following.
- B. Requirements:
 1. Submit paragraph-by-paragraph specification review indicating compliance or deviation with explanation.
 2. Submit proof that all system components and cables are U.L. Listed.
 3. An equipment list with names of manufacturers, model numbers, and technical information on all equipment proposed. Clearly mark exact model number proposed to be installed.
 4. Product technical information sheets for each principal components in the proposed system, including cable, wire, terminal marking, and wire marking material.
 5. Certification from the manufacturer stating that the system Contractor is an authorized distributor or installer of the proposed system when such certifications exist.
 6. A statement listing every technical and operational parameter wherein the submitted equipment varies from that which was originally specified. If the submitter fails to list a particular variance and his submittal is accepted, but is subsequently deemed to be unsatisfactory because of the unlisted variance, the submitter shall replace or modify such equipment at once and without cost to the Owner.

1.18 EXAMINATION OF SITE

- A. The Contractor shall have visited the site and familiarized himself with all existing conditions prior to submitting his proposal and shall be prepared to carry out the work within the existing limitations. Failure or neglect to do so shall not relieve the Contractor of his responsibilities not entitle him to additional compensation for work overlooked and not included in his proposal.
- B. The Contractor shall confirm the availability of the proper power source for each piece of specified equipment, through site visits and Drawings as necessary. Where proper power does not exist, the Contractor shall provide the required power, circuits, outlets, conduits, and wire as specified under Division 26.

1.19 DATA ACCURACY

- A. Absolute accuracy of information regarding existing conditions cannot be guaranteed. The Drawings and Specifications are for the assistance and guidance of the Contractor and exact locations, distances, elevations, etc., shall be governed by actual field conditions. Where variations from the contract documents are required, such variations

shall be approved by the Architect / Owner.

1.20 SECURITY

- A. The Contractor is responsible for complying with all of the Owner's and facility security's requirements to prevent theft or damage to equipment, tools and materials. If any deviation from facility security requirements is necessary, approval for such deviation shall be coordinated with the Owner.
- B. The Contractor shall not disclose any confidential information of the Owner. The Contractor acknowledges that such action is highly injurious and can do damage to the Owner. The Contractor will agree to and comply with the standard policies and provisions of the Owner regarding outside Contractors and Consultants.

1.21 UTILITIES

- A. It shall be the responsibility of the Contractor to provide all temporary connection and cables, lighting, light stands and power. The facilities shall be used in accordance with all applicable regulations regarding operations, safety and fire hazards of the governmental Authorities Having Jurisdiction, provided they are not used in a wasteful manner.

1.22 PERMITS

- A. All permits required for the specified performance and completion of the work shall be secured by the Contractor. These permits shall be presented and reviewed at the initial project progress meeting.

1.23 NOTIFICATION

- A. The Contractor shall not shut off any existing systems. The Contractor shall give the Owner at least ten (10) calendar day's notice of any requirements to shut off or interference with existing alarm, regulating, computer or other service systems. The Owner will arrange and execute any shutdown. All work such as splicing, connections, etc., necessary to establish or re-establish any system shall be completed by the Contractor in close coordination with the Owner.

1.24 INTERFERENCES WITH THE OWNER

- A. Transportation and storage of materials at the facility, work involving the facility, and all other matters affecting the habitual use by the Owner of its buildings, shall be conducted so as to cause the least possible interference, and at times and in a manner acceptable to the Owner. The Contractor shall make every effort to delivery equipment per the schedule required by the project.

1.25 PROJECT RECORD DOCUMENTS

- A. Maintain at the job site a separate set of white prints (blue line or black line) of the contract drawings for the sole purpose of recording the "as-built" changes and diagrams of those portions of work in which actual construction is significantly at variance with the contract drawings. Mark the drawings with a colored pencil. Prepare, as the work progresses and upon completion of work, reproducible drawings clearly indicating locations of various major and minor feeders, equipment, and other pertinent items, as installed. Record underground and underslab cables installed, dimensioning exact location and elevation of such installations.

- B. At conclusion of project, obtain without cost to the Owner, electronic AutoCAD 2014+ / Revit CAD files of the original drawings and transfer as-built changes to these. Provide the following as-built documents including all contract drawings regardless of whether corrections were necessary and include in the transmittal: "2 sets of CDs and prints for Owner's use, one set of CDs, prints, and mylars for Architect / Engineers Records". Delivery of these as-built electronic, reproducible and prints is a condition of final acceptance.
1. 3 sets of electronic AutoCAD (2014+ dwg) / Revit CAD drawing files, on CD-ROM media, of each contract as-built drawing.
 2. One reproducible Dayrex mylar film positive of each contract as-built drawing.
 3. Three sets of blue or black-line prints of each contract as-built drawing.
- C. 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 conduit and cables, etc that were deviated from construction drawings.
 6. Indicate exact location of all underground ESS raceways, and elevations.
 7. Correct schedules to reflect (actual) equipment furnished and manufacturer.
 8. During the execution of work, maintain a complete set of Drawings and specifications upon which all locations of equipment, devices, and all deviations and changes from the construction documents in the work shall be recorded.
 9. Exact location of all ESS equipment in building. Label panel schedules to indicate actual location.
 10. Exact location of all ESS equipment in and outside of the building.
 11. Location, size and routing of all ESS cables, conduits, equipment, etc. shall be accurately and neatly shown to dimension.
 12. Exact location of all roof mounted equipment, wall, roof and floor penetrations.
 13. Cloud all changes.

1.26 OPERATING TESTS

- A. After all ESS systems have been completed and put into operation, subject each system to an operating test under design conditions to ensure proper sequencing and operation throughout the range of operation. Tests shall be made in the presence of the Architect / Engineer and Owner. Provide minimum 24-hour advance notice of scheduling of all tests. Make adjustments as required to ensure proper functioning of all systems. Special tests on individual systems are specified under individual sections. Submit 3 copies of all certifications and test reports adequately in advance of completion of the work to allow for remedial action as required to correct deficiencies discovered in equipment and systems.

1.27 WARRANTY

- A. All equipment shall be covered for the full manufacturers warranty period and systems shall be warranted by the Contractor for a period of two years commencing with the filing date of substantial completion. The Warranty shall cover all costs for warranty service, including parts, labor, prompt field service, pick-up, transportation, delivery, reinstallation, and retesting. A contract for service shall cover the period starting with the first expected activation of each system and shall continue without interruption to cover the period to the end of the two-year warranty as defined above. The end of the warranty period shall be handled such that a smooth transition to a maintenance agreement with the Owner

shall be achieved with no lapse in coverage.

- B. Submit 3 copies of all warranties and guarantees for systems, equipment, devices and materials. These shall be included in the Operating and Maintenance Manuals.

1.28 BUILDING CONSTRUCTION

- A. It shall be the responsibility of the sub-contractor to consult the Architectural and Engineering drawings, details and specifications and thoroughly familiarize himself as to the construction and all job-related requirements. All construction trades shall cooperate with the General Contractor / Construction Manager job site superintendent and lay out work so that all piping, cables, pathways, raceways, and other items are placed in the walls, furred spaces, chases, etc., so that there shall be no delay in the job.

1.29 TEMPORARY FACILITIES

- A. General: Refer to Division 01 for general requirements on temporary facilities.
- B. Temporary Wiring: Temporary power and lighting for construction purposes shall be provided under Division 26. Installation of temporary power shall be in accordance with NEC Article 305.
- C. Temporary facilities, wire, lights and devices are the property of this Contractor and shall be removed at the completion of the Contract.

1.28 EXTRA MATERIALS

- A. Keys: Provide three (3) sets of all keys for system cabinets.

PART 2 - PRODUCTS

2.1 WORK INCLUDED

- A. All materials listed in PART 2 - PRODUCTS of this Division Sections and on the Drawings shall be provided by the Contractor unless specifically excluded or modified in other portions of this Specification or Addendums.

2.2 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.

2.3 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.

2.4 MANUFACTURE'S INSTRUCTIONS

- A. The Contractor is responsible for furnishing the proper Electronic Safety and Security 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 Consultant, in writing, of any conflict between the Contract Documents and the manufacturer's recommendations and shall obtain, from the Consultant, 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 Consultant.

2.5 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.

2.6 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.
- B. All electronic equipment, containing sealed lead acid batteries or gel cells, shall be stored in climate-controlled area until installed or reinstalled. Do not store in non-climate controlled connex storage units.
- C. Storage is to be provided and secured by the contractor. In the event that the Owner should agree to furnish storage space, security of the space and its contents shall remain the responsibility of the contractor.

2.7 CONDITION OF MATERIALS

- A. All materials required for the installation of the Electronic Safety and Security 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 installed, or while being tested, until time of final acceptance, shall be replaced by this Contractor without extra cost to Owner.

2.8 NAMEPLATES

- A. Factory assembled components and equipment shall be provided with be factory stamped labeling. Labeling will have information required to specifically identify the component and/or equipment in the future such as the manufacturer's name, catalog number, serial number, etc. All data on the labels shall be legible at the time of final inspection.

2.9 ACCESS DOORS

- A. Wherever access is required in walls or ceilings to concealed junction boxes, pull boxes, equipment, etc., installed under this Division, furnish a hinged access door and frame with flush latch handle to another Division for installation. Doors shall be as follows:
 - 1. Plaster Surfaces: Milcor Style K.
 - 2. Ceramic Tile Surfaces: Milcor Style M.
 - 3. Drywall Surfaces: Milcor Style DW.
 - 4. Install panels only in locations approved by the Architect.

2.10 SPACE LIMITATIONS

- A. Equipment shall be chosen which shall properly fit into the physical space provided and shown on the drawings, allowing ample room for access, servicing, removal and replacement of parts, etc. Adequate space shall be allowed for clearances in accordance with applicable codes and standards. Physical dimensions and arrangement of equipment shall be subject to the approval of the Consultant.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. This project has a critical path, which must be closely followed in order to meet the completion date. The Contractor shall review the proposed schedule at the Award of Contract meeting and be prepared to staff his work force according to the schedule constraints presented at that time.
- B. Aesthetics are an important consideration in this installation. All components shall be installed so as to have aesthetically pleasing results as determined by the Owner and Architect. Actual locations of all visible components shall be coordinated in advance with the Owner and Architect.
- C. Install, make fully operational and test the system as indicated on the Drawings and in the Specifications. Where information is not available the worst-case condition must be assumed to ensure a complete, functional system.
- D. Any interfacing with other systems shall be the Contractor's responsibility under this contract, and the details, both logical and physical, of such interfaces shall be reflected in the Submittals and As-Built drawings.
- E. If appropriate, interfaces with the Owner's Data Network or Telecommunications System shall be coordinated with the Owner and Architect.
- F. All necessary back boards, back-boxes, pull-boxes, connectors, supports, conduit, cable and wire shall be furnished and installed to provide a complete and reliable system. Exact location of all backboards, boxes, conduit and wiring runs shall be presented to the Owner / Architect for approval in advance of any installation. Provide as required and as specified in Division 26.
- G. Where required provide 120-VAC, 60 Hz power from nearest electrical panel through a junction box, to the system devices. Provide as required and as specified in Division 26.
- H. Where required, install conduit, cable and wire parallel and square with building lines, including raised floor areas. Conduit fills shall not exceed 40%.

- I. All equipment shall be mounted with sufficient clearance to minimize EMI as well as meet all applicable codes and facilitate observation and testing. Securely hand and/or fasten with appropriate fittings to ensure positive grounding, free of ground loops, throughout the entire system. Units shall be installed parallel and square to building lines.
- J. Quiet and vibration-free operation of all equipment is a requirement of this installation. Properly adjust, repair, balance or replace any equipment producing objectionable (in the judgment of the Owner or Architect) noise or vibration in any of the occupied areas of any building and provide additional brackets and bracing if necessary. Any such additions or changes shall be at no additional cost to the Owner.
- K. Installation shall comply with the CODES AND STANDARDS portion of this Section. Where more than one code or regulation if applicable, the more stringent shall apply.
- L. Where new equipment is replacing old equipment, the Contractor is responsible for removing and disposing of the old equipment and doing whatever repair work is necessary as specified by the Owner / Architect.
- M. Install firestopping, as specified in Division 26 for all penetrations in slabs and firewalls to meet code at the completion of work and prior to final testing demonstration to the Owner.
- N. The installation shall be performed in a professional manner.
- O. On a daily basis, clean up and deposit in appropriate containers all debris from work performed under the appropriate specification sections. Stack and organize all parts, tools and equipment when not being used.
- P. Preparation, handling and installation shall be in accordance with the Manufacturer's written instructions and technical data appropriate to the product specified.
- Q. All work shall conform to the National Electrical Contractor's Association "Standard of Installation" for general installation practice.
- R. At the conclusion of the installation, all work areas, including all enclosures and boxes, shall be vacuumed and cleaned to remove all debris and grease.

3.2 COORDINATION WITH OWNER / ARCHITECT

- A. Close coordination with the Owner / Architect is vital to achieve a complete, aesthetically pleasing job. The Contractor shall ensure that the Owner / Architect is kept fully apprized of job progress.

3.3 CUTTING, PAINTING, AND PATCHING

- A. Structural members shall not be drilled, bored or notched in such a manner that shall impair their structural value. Cutting of holes in structural members, if required, shall be done with core drills and only with the specific approval of the Owner / Architect for each instance.
- B. All walls that require cutting or repair during the installation process shall be returned to their original condition, including the matching of colors and finishes to the satisfaction of the Owner / Architect, and at no additional cost to the Owner.

3.4 WIRE AND CABLE

- A. All low voltage cable shall be low smoke plenum rated, limited energy, with 300-volt insulation.
- B. All wires in exposed areas shall run through conduit as specified in Division 26.
- C. Provide conduits, cable trays, raceways, wireways, boxes and outlets as specified in Division 26.
- D. After installation, and before termination, all wiring shall be checked and tested to insure there are no grounds, opens, or shorts on any conductors. In addition, all wires between buildings or underground and all coax cables shall have insulation tested with a megohmmeter (megger) and a reading of greater than 20 megohms shall be required to successfully complete the test.
- E. Run wires continuously from termination to termination without splices.
- F. Wire and cable shall be supported in each equipment and terminal cabinet and in each terminal and pull box in vertical risers and horizontal runs with wire duct and strap-type supports. At any point where wire duct is required for good wire management, whether shown on elevations or not, install appropriate duct. Where terminal boards are used, wire ducts shall be supplied on both sides and at no time shall wires cross over terminal boards. Arrange cables neatly to allow inspection, removal and replacement. Lace cables as required. Spot tie wire bundles with plastic cable ties and securely affix to panels. If screw type terminals are specified, terminal strip connections shall be locking, tongue style, pressure crimp, and solderless spade lug.
- G. Visually inspect wire and cable for faulty insulation prior to installation. Protect cable ends at all times with acceptable end caps except during actual termination. At no time shall any coaxial cable be subjected to a bend less than a 6-inch radius. Protect wire and cable from kinks. Install 1 pull rope for all 2" or larger sized conduits.
- H. Provide plastic bushings and strain relief material at all conduit exit points and where necessary, to avoid abrasion of wire and excess tension on wire and cable.
- I. Cables above accessible ceilings shall not rest on ceiling tiles. Use Velcro tie wraps, J-hooks or D-rings to hold cables. Provide independent support for all cables. Support is to be from building structure (do not support from pipes or conduits). ESS cables shall not tie off on HVAC supports, all-thread, ceiling grid hanger wire or electrical / mechanical piping system.
- J. Ground and bond equipment and circuits in accordance with NEC and Division 26.

3.5 IDENTIFICATION AND TAGGING

- A. All cables, wires, wiring forms, terminal blocks and terminals shall be identified by labels, tags to other permanent markings in accordance with TIA/EIA-606. The markings shall clearly indicate the function, source, or destination of all cabling, wiring and terminals. All cables and wires shall be identified, utilizing heat-shrink, machine printed, polyolefin wire markers (Brady Type B-32 or equal). Handwritten tags are not acceptable.
- B. Should a situation arise where the wire tagging format as shown on the drawings cannot be used, a substitute format shall be submitted which complies with the intent to provide

documentation that will permit end-to-end tracing of all ESS Systems wiring.

- C. All panels shall be provided with permanently attached engraved lamacoid labels with identifying names and functions. All terminal points shall be appropriately labeled. Labels shall be consistent in form, color, and typeface throughout the system and all must contain the name of the system or subsystem as part of the label textual information. Design, color, font and layout shall be coordinated with, and approved by, the Owner.
- D. Identification of Equipment:
 - 1. All major equipment shall have a manufacturer's label identifying the manufacturer's address, equipment model and serial numbers, equipment size, and other pertinent data. Take care not to obliterate this nameplate. The legend on all nameplates or tags shall correspond to the identification shown on the Operating Instructions.
 - 2. A black-white-black 3-layer laminated plastic engraved identifying nameplate shall be permanently secured to each wireway, terminal cabinet, and ESS cabinet or rack.
 - a. Identifying nameplates shall have 1/2-inch high, engraved letters.
 - 3. Permanent, waterproof, black markers shall be used to identify each ESS grid junction box, clearly indicating the type of system available at that junction box.
 - 4. Pull Boxes: Field work each with a nameplate showing identity, and identifying equipment connected to it. Nameplates shall also indicate where pull box is fed from.
- E. Prohibited Markings: Markings intended to identify the manufacturer, vendor, or other source from whom the material has been obtained are prohibited for installation in public, tenant, or common areas within the project. Also prohibited are materials or devices that bear evidence that markings or insignias have been removed. Certification, testing (example, Underwriters Laboratories), and approval labels are exceptions to this requirement.
- F. Warning Signs: Provide warning signs where there is hazardous exposure associated with access to or operation of ESS facilities. Provide text of sufficient size to convey adequate information at each location; mount permanently in an appropriate and effective location. Comply with industry standards for color and design.
- G. Wire and Cable Labeling: Provide wire markers on each conductor in all boxes, pull boxes, gutters, wireways. Identify with drop/circuit number.
- H. Underground Warning Tape: Thomas and Betts or approved equal. Six-inch wide plastic tape, colored red or orange with suitable warning legend describing buried ESS lines. All underground conduits shall be so identified. Tape shall be buried at a depth of 6-inches below grade and directly above conduits or ductbanks. Provide magnetic marking tape below all underground conduits.

3.6 CUTTING AND PATCHING

- A. General: Comply with the requirements of Division 01 for the cutting and patching of other work to accommodate the installation of electrical work. Except as authorized by the Architect / Engineer, cutting and patching of electrical work to accommodate the installation of other work is not permitted.

3.7 INSTRUCTION OF OWNER'S PERSONNEL

- A. Before proceeding with the instruction of Owner Personnel, prepare a typed outline, listing the subjects that will be covered in this instruction, and submit the outline for review by the Owner. At the conclusion of the instruction period obtain the signature of each person being instructed on each copy of the reviewed outline to signify that he has a proper understanding of the operation and maintenance of the systems and resubmit the signed outlines.
- B. Prior to substantial completion, conduct an on-site training program to instruct Owner's operating personnel in the operation and maintenance of the ESS systems.
 - 1. Provide the training during regular working day.
 - 2. The Instructors shall be experienced in their phase of operation and maintenance of the electrical systems and with the project.
- C. Time to be allocated for instructions.
 - 1. Minimum of 12 hours dedicated instructor time
 - 2. 4 hours on each of 3 days
 - 3. Additional instruction time for specific systems as specified in other Sections.
- D. Before on-site training, submit the program syllabus; proposed time and dates; for review and approval, minimum 48 hours prior to proposed training time and date.
 - 1. One copy to the Owner
 - 2. One copy to the Architect / Engineer
- D. The Owner shall provide a list of personnel to receive instructions and shall coordinate their attendance at the agreed upon times.
- E. Use operation and maintenance manuals as the basis of instruction. Review manual with personnel in detail. Explain all aspects of operation and maintenance.
- F. Demonstrate start-up, operation, control, adjustment, troubleshooting, 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 training. List time and date of each demonstration, hours devoted to the demonstration, and a list of people present, with their respective signatures.
- 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 Operating and Maintenance Manual.

3.8 OPENINGS

- A. Framed, cast or masonry openings for boxes, equipment or conduits are specified under

other divisions. Drawings and layout work for exact size and location of all openings are included under this division.

3.9 OBSTRUCTIONS

- A. The drawings indicate certain information pertaining to surface and subsurface obstructions, which has been taken from available drawings. Such information is not guaranteed, however, as to accuracy of location or complete information.
 - 1. Before any cutting or trenching operations are begun, verify with Owner's representative, utility companies, municipalities, and other interested parties that all available information has been provided.
 - 2. Should obstruction be encountered, whether shown or not, alter routing of new work, reroute existing lines, remove obstruction where permitted, or otherwise perform whatever work is necessary to satisfy the purpose of the new work and leave existing services and structures in a satisfactory and serviceable condition.
- B. Assume total responsibility for and repair any damage to existing utilities or construction, whether or not such existing facilities are shown.

3.10 VANDAL RESISTANT DEVICES

- A. Where vandal resistant screws or bolts are employed on the project, deliver to the Owner 2 suitable tools for use with each type of fastener used.
- B. Proof of delivery of these items to the Owner shall be included in the Operating and Maintenance Manuals.

3.11 PROTECTION

- A. Protect work, equipment, fixtures, and materials. At work completion, work must be clean and in original manufacturer's condition.
- B. Do not deliver equipment to this 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 shall be rejected, and the contractor is obligated to furnish new equipment of a like kind at no additional cost to the Owner.

3.12 EQUIPMENT BACKBOARDS

- A. Backboards: $\frac{3}{4}$ inch, fire retardant, exterior grade plywood, painted gray, both sides.
 - 1. Provide minimum of two 4-ft. by 8-ft. sheets of plywood for each location shown.
 - 2. Provide minimum of two 4-ft. by 4-ft. sheets of plywood for each ESS location.

3.13 SITE MANAGEMENT RESPONSIBILITY

- A. The Contractor shall provide an on-site Project Manager as defined in CONTRACTOR'S QUALIFICATIONS portion of this Section.

3.14 DEMOLITION AND RELOCATION

- A. 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.

- B. 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 Consultant. Where items scheduled for relocation and/or reuse are considered unsuitable for reuse, the Contractor shall so notify the Consultant 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 no additional cost to the Owner or the Consultant.
- C. 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.
- D. 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 Consultant.

3.15 EXISTING SYSTEM TESTING

- A. Contractor shall have each low voltage system tested prior to the commencement of construction. Systems shall include all systems that fall under the Division 28 umbrellas, as identified in the Division 2 of the Construction Specifications Institute (CSI) current Master Format7 Test shall include the functionality of all field devices and equipment. Any failures or items found to be functioning not to specification, shall be reported prior to construction. Any items found to be improperly or non-functioning upon the completion of the project, shall be replaced and/or repaired, by the contractor, at no additional cost to the project or the owner.
- B. Contractor shall document the location and any ID tag, MAC address, IP address, or bar code of any existing device that is to be removed from its current location. Devices that are to remain, shall be reinstalled in the exact location that they reside in prior to construction, unless noted otherwise.
- C. Any individual/firm that will be removing, relocating, reinstalling, or tampering with any devices; shall be licensed by the state and certified by the manufacturer of the system.
- D. Contractor shall remove any devices where construction occurs to prevent possible damage to the device. Removal of any devices which support user connection or other systems, shall be coordinated with the owner prior to removal and/or taking offline.

3.16 START-UP RESPONSIBILITY

- A. The Contractor shall initiate System operation. The Contractor shall provide competent Start-Up personnel on each consecutive working day until all ESS Systems are functional and ready to start the acceptance test phase. If the Contractor, in the Owner / Architect's judgment, is not demonstrating progress in solving any technical problems, the Contractor shall supply Manufacturer's factory technical representation and diagnostic equipment at no cost to the Owner, until resolution of those defined problems. Where appropriate, the Contractor shall bring the Systems on-line in their basic state (i.e., alarm reporting, facility code access control, etc.) It is the responsibility of the Owner to provide the specific database information that will be utilized for initial system programming.
- B. Properly ground each piece of electronic equipment prior to applying power. Properly ground all shielded wire shields to the appropriate earth ground at the hub end only, not at the remote or device end.
- C. Use a start-up sequence that incrementally brings each portion of the system on-line in a logical order that incorporates checking individual elements before proceeding to subsequent elements until the entire system is operational. The basic steps should include:
 - 1. Establish ground planes at the equipment rooms and hub end of the systems as specified in Division 26.
 - 2. Disconnect power, connect the first device, reconnect power, and verify operational correctness. Repeat until the entire system is verified and operational.

3.17 PREPARATION FOR ACCEPTANCE (SUBSTANTIAL COMPLETION)

- A. All systems, equipment, and devices shall be in full and proper adjustment and operation, and properly labeled and identified.
- B. All materials shall be neat, clean and unmarred, and parts securely attached.
- C. All extra material as specified shall be delivered and stored at the premises as directed.
- D. Test reports of each system and each system's components and As-Built Project Drawings shall be complete and available for inspection and delivery as directed by the Owner.

3.18 SYSTEM ACCEPTANCE REQUIREMENTS

- A. Before final acceptance or work, the Contractor shall perform and/or deliver each of the following in the order stated.
- B. The Contractor shall deliver three (3) composite "System Operations and Maintenance" manuals in three-ring binders, sized to hold the material below, plus 50% excess. Each manual shall contain in appropriately tabbed sections:
 - 1. A statement of Guarantee including date of termination and the name and phone number of the persons to be called in the event of equipment failure.
 - 2. A set of Operating procedures for the overall System that includes all required Owner activities, and that allows for the Owner operation of all attributes and facilities of the System.
 - 3. A section for each specific type of equipment containing the vendor manuals, instruction sheets, and any related literature that came in the original shipping container for that piece of equipment. Include all warranty cards.

- C. Testing:
1. The Contractor shall perform all tests required by Division 28 and those submitted as part of this Section.
 2. The Contractor shall activate all devices for proper system operation, including supervisory and trouble circuit tests. Similarly, audible alarms will not be activated except on a one-time, coordinated basis, to check the actual sounding devices.
 3. A test report for each piece of equipment shall be prepared by the Contractor and submitted to the Owner. This report shall include a complete listing of every device, the date it was tested, by whom and the results. The final test reports shall indicate that every device tested successfully. Failure to completely test and document the tests will result in a delay of final testing and acceptance.
- D. As-Built Drawings:
1. After completion of all the tests listed above, and prior to the final acceptance test, The Contractor shall submit the complete As-Built drawings as identified in PART 1 – PROJECT RECORD DRAWINGS.
 2. The final As-Built Drawings shall consist on one set of reproducible prints, two (2) sets of Point-to-Point Detail Drawings, Equipment Schedules, and the complete detailed technical data that was shipped by the manufacturer with all installed equipment.
- E. Final Acceptance Test: The Final Acceptance Test shall demonstrate the installed and activated System's performance and compliance with System Specifications. However, before this testing can begin the following must have received and reviewed by the Owner.
1. System Operations and Maintenance Manuals
 2. System Test Reports
 3. As-Built Drawings

3.19 NOTICE OF COMPLETION

- A. When the Final System Acceptance Requirements described above including the Final Acceptance Test described above have been satisfactorily completed. The Owner / Architect shall issue a Letter of Completion to the Contractor indicating the date of such completion. The Notice of Completion shall be recorded by the Contractor upon receipt of the Owner / Architect completion letter. This date of record shall be the start of the warranty period.

END OF SECTION

**SECTION 28 05 07 - SHOP DRAWINGS, COORDINATION DRAWINGS
& PRODUCT DATA**

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Prepare submittals as required by Division 1 and as outlined below.
- B. Submit product data shop drawings only for the following and for items specifically requested elsewhere in the Contract Drawings and Specifications. Architect / Engineer reserves the right to refuse shop drawings not requested for review and to imply that materials shall be provided as specified without exception.
- C. The term submittal, as used herein, refers to all:
 - 1. Shop Drawings
 - 2. Coordination Drawings
 - 3. Product data
- D. Submittals shall be prepared and produced for:
 - 1. Distribution as specified
 - 2. Inclusion in the Operating and Maintenance Manual, as specified, in the related section

1.2 SHOP DRAWINGS

- A. Present drawings in a clear and thorough manner. Identify details by reference to sheet and detail, schedule, or room numbers shown on Contract Drawings.
- B. Show all dimensions of each item of equipment on a single composite Shop Drawing. Do not submit a series of drawings of components.
- C. Identify field dimensions; show relation to adjacent or critical features or work or products.

1.3 COORDINATION DRAWINGS

- A. Present in a clear and thorough manner. Title each drawing with project name. Identify each element of drawings by reference to sheet number and detail, or room number of contract documents. Minimum drawing scale: 1/4"=1'-0".
- B. Prepare coordination drawings to coordinate installations for efficient use of available space, for proper sequence of installation and to resolve conflicts. Coordinate with work specified in other sections and other divisions of the specifications.
- C. For each room containing ESS equipment and each rack with ESS equipment, submit plan and elevation drawings. Show:
 - 1. Actual ESS equipment and components to be furnished.
 - 2. NEC working space and NEC access to NEC working space.
 - 3. Relationship to other equipment and components and openings, doors and obstructions
 - 4. Rack location and dimensions
- D. Identify field dimensions. Show relation to adjacent or critical features of work or products.

- E. Verify location of ESS station devices and other work specified in this Division.
 - 1. Coordinate with drawing details, site conditions and millwork shop drawings prior to installation.
 - 2. Where required for clarification, submit shop drawings prior to rough-in and fabrication.
- F. Submit shop drawings in plan, elevation and sections, showing outlets and other devices in casework, cabinetwork and built-in furniture.

1.4 PRODUCT DATA

- A. All product options specified shall be indicated on the product data submittal. All options listed on the standard product printed data not clearly identified as not part of the product data submitted shall become part of the Contract and shall be provided.
- B. Mark each copy of standard printed data to identify pertinent products, referenced to specification section and article number.
- C. Show reference standards, performance characteristics and capacities; wiring and piping diagrams and controls; component parts; finishes; dimensions and required clearances.
- D. Modify manufacturer's standard schematic drawings and diagrams to supplement standard information and to provide information specifically applicable to the work. Delete information not applicable.
- E. Mark up a copy of the specifications for the product to indicate a) acknowledgement of the specification requirement (Comply), or b) acknowledgement that the particular specification requirement does not apply to this specific project (Not Applicable) or, c) acknowledgement that the specification requirement cannot be made or that a variance is being submitted for review to the Architect / Engineer/Owner (Does Not Comply, Explanation:)

1.5 MANUFACTURERS INSTRUCTIONS

- A. Submit Manufacturer's instructions for storage, preparation, assembly, installation, start-up and adjusting.

1.6 CONTRACTOR RESPONSIBILITIES

- A. Review submittals prior to transmittal.
- B. Determine and verify:
 - 1. Field measurements
 - 2. Field construction criteria
 - 3. Manufacturer's catalog numbers
 - 4. Conformance with requirements of Contract Documents
- C. Coordinate submittals with requirements of the work and of the Contract Documents.
- D. Notify the Architect / Engineer in writing at time of submission of any deviations in the submittals from requirements of the Contract Documents.
- E. Do not fabricate products, or begin work for which submittals are specified, until such submittals have been produced and bear contractor's stamp. Do not fabricate products or begin work scheduled to have submittals reviewed until return of reviewed submittals with

Architect / Engineer's acceptance.

- F. Contractor's responsibility for errors and omissions in submittals is not relieved whether Architect / Engineer reviews submittals or not.
- G. Contractor's responsibility for deviations in submittals from requirements of Contract Documents is not relieved whether Architect / Engineer reviews submittals or not, unless Architect / Engineer gives written acceptance of the specific deviations on reviewed documents.
- H. Submittals shall show sufficient data to indicate complete compliance with Contract Documents:
 - 1. Proper sizes and capacities
 - 2. That the item will fit in the available space in a manner that will allow proper service
 - 3. Construction methods, materials and finishes
- I. Schedule submissions at least 15 days before date reviewed submittals will be needed.

1.7 SUBMISSION REQUIREMENTS

- A. Make submittals promptly in accordance with approved schedule, and in such sequence as to cause no delay in the Project or in the work of any other Contractor.
- B. Number of submittals required:
 - 1. Shop Drawings and Coordination Drawings: Submit four opaque reproductions.
 - 2. Product Data: Submit the number of copies the contractor requires, plus those to be retained by the Architect / Engineer.
- C. Accompany submittals with transmittal letter, in duplicate, containing:
 - 1. Date
 - 2. Project title and number
 - 3. Contractor's name, address and telephone number
 - 4. The number of each Shop Drawing, Project Datum and Sample submitted
 - 5. Other pertinent data
- D. Submittals shall include:
 - 1. The date of submission
 - 2. The project title and number
 - 3. Contract Identification
 - 4. The names of:
 - a. Contractor
 - b. Subcontractor
 - c. Supplier
 - d. Manufacturer
 - 5. Identification of the product
 - 6. Field dimensions, clearly identified as such
 - 7. Relation to adjacent or critical features of the work or materials
 - 8. Applicable standards, such as ASTM or federal specifications numbers
 - 9. Identification of deviations from contract documents
 - 10. Suitable blank space for General Contractor and Architect / Engineer stamps
 - 11. Contractor's signed and dated Stamp of Approval
- E. Coordinate submittals into logical groupings to facilitate interrelation of the several items.
 - 1. Finishes which involve Architect / Engineer selection of colors, textures or

- patterns
- 2. Associated items requiring correlation for efficient function or for installation

1.8 SUBMITTAL SPECIFICATION INFORMATION

- A. Every submittal document shall bear the following information as used in the project manual:
 - 1. The related specification section number
 - 2. The exact specification section title
- B. Submittals delivered to the Architect / Engineer without the specified information will not be processed. The Contractor shall bear the risk of all delays, as if no submittal had been delivered.

1.9 RESUBMISSION REQUIREMENTS

- A. Make resubmittals under procedures specified for initial submittals.
 - 1. Indicate that the document or sample is a resubmittal
 - 2. Identify changes made since previous submittals
- B. Indicate any changes which have been made other than those requested by the Architect / Engineer.

1.10 CONTRACTOR'S STAMP OF APPROVAL

- A. Contractor shall stamp and sign each document certifying to the review of products, field measurements and field construction criteria, and coordination of the information within the submittal with requirements of the work and of Contract Documents.
- B. Contractor's stamp of approval on any submittal shall constitute a representation to Owner and Architect / Engineer that Contractor has either determined and verified all quantities, dimensions, field construction criteria, materials, catalog numbers, and similar data or assumes full responsibility for doing so, and that Contractor has reviewed or coordinated each submittal with the requirements of the work and the Contract Documents.
- C. Do not deliver any submittals to the Architect / Engineer that do not bear the Contractor's stamp of approval and signature.
- D. Submittals delivered to the Architect / Engineer without Contractor's stamp of approval and signature will not be processed. The Contractor shall bear the risk of all delays, as if no submittal had been delivered.

1.11 ARCHITECT / ENGINEER REVIEW OF IDENTIFIED SUBMITTALS

- A. The Architect / Engineer will:
 - 1. Review identified submittals with reasonable promptness and in accordance with schedule. Specific equipment submittals that may be required to be expedited shall be submitted separately without other submittal items not requiring the same prompt attention.
 - 2. Affix stamp and initials or signature, and indicate requirements for resubmittal or approval of submittal
 - 3. Return submittals to Contractor for distribution or for resubmission
- B. Review of submittals will not extend to design data reflected in submittals that is

peculiarly within the special expertise of the Contractor or any party dealing directly with the Contractor.

- C. Architect / Engineer's review is only for conformance with the design concept of the project and for compliance with the information given in the contract.
 - 1. The review shall not extend to means, methods, sequences, techniques or procedures of construction or to safety precautions or programs incident thereto.
 - 2. The review shall not extend to review of quantities, dimensions, weights or gauges, fabrication processes or coordination with the work of other trades.
- D. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.

1.12 SUBSTITUTIONS

- A. Do not make requests for substitution employing the procedures of this Section.
- B. The procedure for making a formal request for substitution is specified in Division 01.

PART 2 - PRODUCTS - NOT USED.

PART 3 - EXECUTION

3.1 SHOP DRAWINGS AND PRODUCT DATA

- A. Submittals shall not be combined or bound together with any other material submittal.
- B. Submit individually bound shop drawings and product data for the following when specified or provided:
 - 1. Low Voltage Wire
 - 2. Electronic Access Control and Intrusion Detection
 - 3. Electronic Surveillance
 - 4. Fire Detection and Alarm

3.2 COORDINATION DRAWINGS

- A. Submit coordination drawings as specified.

END OF SECTION

SECTION 28 05 10 - CONTRACT QUALITY CONTROL

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Contract quality control including workmanship, manufacturer's instructions, mock-ups and demonstrations.

1.2 QUALITY CONTROL PROGRAM

- A. Maintain quality control over supervision, subcontractors, suppliers, manufacturers, products, services, site conditions and workmanship to produce work in accordance with contract documents.

1.3 WORKMANSHIP

- A. Comply with industry standards except when more restrictive tolerances or specified requirements indicate more rigid standards or more precise workmanship.
- B. Perform work by persons qualified to produce workmanship of specified quality.
- C. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, and racking. Under no conditions shall material or equipment be suspended from structural bridging.
- D. Provide finishes to match approved samples; all exposed finishes shall be approved by the Architect / Engineer. Submit color samples as required.

1.4 MANUFACTURER'S INSTRUCTIONS

- A. Comply with instructions in full detail, including each step in sequence.
- B. Should instruction conflict with Contract Documents, request clarification from Architect / Engineer before proceeding.

1.5 MANUFACTURER'S CERTIFICATES

- A. When required in individual Specification Sections, submit manufacturer's certificate in duplicate, certifying that products meet or exceed specified requirements.

1.6 MANUFACTURER'S FIELD SERVICES

- A. When required in individual Specification Sections, manufacturer shall provide a manufacturer's qualified personnel to observe:
 - 1. Field conditions.
 - 2. Condition of installation.
 - 3. Quality of workmanship.
 - 4. Start-up of equipment.
 - 5. Testing and adjusting of equipment.
- B. Manufacturer's qualified personnel shall make written report of observations and recommendations to Architect / Engineer.

1.7 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 where possible.
- D. Perform tests and submit results as specified.

1.8 SCHEDULING OF MOCK-UPS

- A. Schedule demonstration and observation of mock-ups, in phases, with Architect / Engineer.
 - 1. Rough-in
 - 2. Finish with all appurtenances in place
 - 3. Demonstrations

PART 2 - PRODUCTS

2.1 REFERENCE APPLICABLE SPECIFICATION SECTIONS

PART 3 - EXECUTION

3.1 ADJUSTMENTS AND MODIFICATIONS

- A. Contractor shall provide all adjustments and modifications as requested by the manufacturer's qualified personnel at no additional cost to Owner.

3.2 MOCK-UPS

- A. Mock up a typical classroom, science lab of each type, and computer lab with all wiring devices, cover plates, rough-in boxes, conduits, etc. provide all conductors from all wiring devices to above ceiling space to demonstrate conduit routing and conductor fill.

END OF SECTION

SECTION 28 05 50 - FIRESTOPS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Provide firestop as required, and as specified. Refer to Architectural drawings for all fire and smoke rated partitions, walls, floors, etc.
- B. Types: Firestop required for the project includes smokestop.

1.2 QUALITY ASSURANCE

- A. UL Label: Firestops shall be UL labeled.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Nelson.
- B. 3M (Minnesota Mining Manufacturing).
- C. Hilti
- D. Specified Technologies, Inc.

2.2 MATERIAL AND COMPONENTS

- A. General: Except as otherwise indicated, provide firestop manufacturer's standard materials and components as indicated by published product information, designed and constructed as recommended by the manufacturer, and as required for installation.

2.3 FIRESTOP

- A. Conduits: Provide a soft, permanently flexible sealant for 1-1/2 to 2 hour rated fireproofing for steel conduits (up to 4" diameter).
- B. Low Voltage Cables, Fiber Optic Cable and Innerduct: Provide Specified Technologies, Inc. EZ-Path single, double, or triple pathways as required.

PART 3 - EXECUTION

3.1 INSTALLATION OF FIRESTOPS

- A. General: Install firestops in accordance with the manufacturer's installation instructions and industry practices to ensure that the firestops comply with requirements. Comply with UL and NFPA standards for the installation of firestops.

END OF SECTION

SECTION 28 10 00 - ACCESS CONTROL SYSTEM (ACS)

PART 1 - GENERAL

1.1 RELATED WORK

- A. The following, in their entirety and as applicable, shall apply to this section. Including any associated drawings.
 - 1. Conditions of the Contract
 - 2. Division 1
 - 3. Division 26
 - 4. Division 27
 - 5. Division 28

1.2 WORK INCLUDED

- A. Reference Attachment 'A' of this specification for supplemental scope and product material list as it relates to the project and the Owner standards.
- B. ACS devices indicated are for reference and coordination purposes only. The System Installer shall design and provide a complete system, meeting the requirement of specification. Installer shall provide all system devices required to established controlled access and monitoring at locations designated in the contract documents. The system installation shall be in compliance with all governing authorities and the Architect, Engineer, and Owner expectations.
- C. Security system devices indicated are for reference and coordination purposes only. The System Installer shall design and provide a complete system, meeting the requirement of specification. The installer shall provide all security system devices required for complete system perimeter coverage acceptable to all governing authorities, Architect and Owner.
- D. The system shall include security for all access into building, including but not limited to the following:
 - 1. Control Panels
 - 2. Power Supplies
 - 3. Interconnection of panels
 - 4. Installation of new devices
 - 5. Card reader
 - 6. Magnetic locking hardware
 - 7. Request to exit devices
 - 8. Door position sensors
 - 9. Door Hardware (as specified herein and/or in Division 08, door hardware)
 - 10. Lockdown and Lockout Buttons
 - 11. Audio / Video Intercom Systems
 - 12. All additional material, hardware, and labor required for a fully functional, turnkey system
- E. The System Installer shall connect each controller to the ACS Management System.
- F. All system programming will be performed by the system installer. The system installer will be required to meet with the Owner, engineer, and system manager to discuss wiring and termination of the system control panels and field devices prior to installation.
- G. Licensing: The System Installer shall NOT utilize any of the owner's existing licensing for this scope of work. All licensing shall be provided by the System Installer, no exceptions.

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Including, but not limited to the following:

1. Portal Licensing
 2. Controller Licensing
 3. Wireless Licensing
 4. Video Management Software Integration Licensing
- H. System Installer to refer to Division 08 Door Hardware Specification. Provide and install all hardware specified to be provided by the "Access Control Contractor", "Security Installer", "Division 28", or any variation thereof.
- I. System Installer to provide and install door hardware as specified in Specification Section 28 10 00.10 Access Control Hardware Devices - and 28 10 00.05 Access Control Hardware Devices
- J. The documents issued for this project are conceptual in nature, including but not limited to specifications and drawings. It shall be the responsibility of the approved installer to furnish a complete and functional system, including the items shown on the drawings, in the specifications, and items not designated in either. The installer's shop drawings and product data submittals shall represent a complete system, and documents accepted do not relieve the installer from being required to provide any materials, equipment, or labor to furnish a complete and functional system as recognized by the Project's Technology Consultant and the Owner.

1.3 REFERENCES

- A. Code of Federal Regulations (CFR).
- B. Institute of Electrical and Electronics Engineers (IEEE):
1. 802.3 Ethernet Standards.
 2. IEEE 1100 Recommended Practice for Powering and Grounding Electronic Equipment.
- C. International Electrotechnical Commission (IEC).
- D. International Organization for Standardization (ISO):
1. ISO / IEC 10918 - Information technology -- Digital compression and coding of continuous-tone still images: Requirements and guidelines; JPEG.
 2. ISO / IEC 14496-10 - Information Technology - Coding Of Audio-Visual Objects - Part 10: Advanced Video Coding; MPEG-4 Part 10 (ITU H.264).
 3. ISO / IEC 23008-2 - High Efficiency Coding and Media Delivery In Heterogeneous Environments - Part 2: High Efficiency Video Coding; MPEG-H Part2 (ITU H.265, HEVC).
- E. Federal Communications Commission (FCC):
1. FCC Part 15 – Radio Frequency Device
- F. Underwriters Laboratories (UL):
1. UL294 – Access Control Systems Units
- G. Electronic Industries Alliance (EIA)
1. RS485 - Electrical Characteristics of Generators and Receivers for use in Balanced Digital Multi-Point Systems
- H. Federal Information Processing Standards (FIPS)
1. Advanced Encryption Standard (AES) (FIPS197)
 2. FIPS201-2: Open Options DNA Fusion FIPS in conjunction with an E2-SSP-D2-

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FIPS, NSC-100-FIPS, RSC-2-FIPS and other listed components will provide an access control solution that is fully FIPS 201-2 compliant.

3. Personal Identity Verification (PIV) of Federal Employees and Contractors
 - I. Homeland Security Presidential Directive 12 (HSPD12)
 - J. National Fire Protection Association Standards:
 1. NFPA 70 - National Electrical Code
 2. NFPA 72 - National Fire Alarm Code
 3. NFPA 101 - Life Safety Code
 - K. RoHS compliant
 - L. SIA AC-01-1996.10 - Access Control - Wiegand
 - M. Local & State Building Codes
 - N. Requirements of Local Authorities having Jurisdiction
 - O. Requirements of American Disabilities Act (Public law 101-336).
 - P. Texas Accessibility Standards (TAS)
 - Q. Texas Insurance Code.

1.4 QUALITY ASSURANCE

- A. System Installer Qualifications:
 1. The System Installer shall be the authorized representative of the Access Control Manufacturer to sell, install, and service the proposed manufacturer's equipment. The System Installer shall have represented the security alarm manufacturer's product for at least two years.
 2. The System Installer shall be licensed as required, by the State in which the project is located in, as a security services contractor to design, sell, install, and service security alarm systems.
 3. The System Installer shall provide 24-hour, 365 days per year emergency service with factory trained service technicians.
 4. The installing firm 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.
 5. The System Installer 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.
 6. The proposing System Installer for this system and the installer of this system shall be of the same organization. Absolutely no subcontracting of any portion of this system by the proposing System Installer will be allowed.
 7. The proposing/installing contractor of this system must be an authorized dealer / integrator for the project's specified Video Surveillance and the Intrusion Detection systems as well as the system specified in this section.
 8. For proper, smooth, and complete integration of the IP security camera, access control, and intrusion detection systems; the proposing/installing contractor of the video surveillance and intrusion detection systems must be the same contractors.
 9. The System Installer must be a current integrator of solution in the closest major metropolitan area marketplace, have a permanent office located within 75-miles

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of the project, and be able to include information on current support staff to be able to service this client.

10. The System Installer must be in good standing with the Owner and have no outstanding performance or warranty items at the time of bid. Any outstanding items or issues is grounds to disqualify the System Installer for performing any work on the project.

1.5 SUBMITTALS AND CLOSE-OUT

- A. Product Data: Within fourteen (14) days of Notice to Proceed, the 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 system equipment, power supplies, cable, termination components, cable supports, cable labels, field 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 submitted.
 3. Construction Schedule: A time-scaled Construction Schedule indicating general project deadlines and specific dates relating to the installation of the cable distribution system.
 4. Specification Compliance: A letter shall be provided stating, by section and subsection, that the 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.
 5. Certifications: The System Installer shall submit all of the following certifications and the certifications 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.
 - a. Manufacturer's Authorized Dealer/Installer Certification: This certification must be held by the proposing/installing contractor and state that the proposing/installing contractor is and authorized dealer/installer of the system specified within the project specifications. The certification must have been obtained by the office that is within a 75-mile radius of the project's location.
 - b. 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.
 - c. Licenses: This includes all licenses required by the state in which the work is being performed, the federal government, local authorities having jurisdiction, and any organization in that governs the specific system
- B. Shop Drawings: Submit the following items, for Owner review and approval, within twenty-eight (28) days of notice to proceed:
 1. Proposed circuit routing and circuit grouping plan prepared by a system registered designer. The designer's certification must be current. Identifiable, separate routing shall be shown for both the station cabling and any backbone trunk cabling.
 2. 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:
- a. Location of all control equipment and remote power sources
 - b. Locations of all field devices and outlets
 - c. Location of wall penetrations (all penetrations shall be sleeved and contain protective bushings at both ends)
 - d. Location of sleeved wall and/or floor pass-thru
 - e. Size of sleeve at each location installed
 - f. Quantity of cable passing through each sleeve
 - g. Conduit routing, size, quantity, and stub-up locations for any floor mounted outlets or outlets installed in casework.
3. Drawing Compliance: A letter shall be provided stating that the 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 approved by the project's technology consultant.
- C. Close-out Procedures: For review and acceptance, furnish an electronic copy of the following documents to the Architect / Engineer. Upon acceptance of the submitted close-out documents, provide four (4) copies on an electronic storage media (CD or USD Flash Drive) Labeled with the project name, date of submission, and the name of the submitting firm. Final copies shall be delivered directly to the project's Technology Consultant. The closeout submittals shall include the following and be packaged in a storable container with the physical storage media and any physical items listed:
1. Inspection and Test Reports: During the course of the Project, the System Installer shall maintain an adequate inspection system to ensure that the materials supplied, and the work performed, conform to contract requirements. The System Installer shall provide written documentation that indicates that materials acceptance testing was conducted as specified. The System Installer shall also provide documentation, which indicates that all cable termination testing was completed and that all irregularities were corrected prior to job completion.
 2. Provide complete test reports for all cabling and devices that comprise system as outlined in this document.
 3. Include the Name, address and telephone of the authorized factory representative with a 24-hour emergency service number.
 4. The manual shall also include Manufacturer's data sheets and installation manuals/instructions for all equipment installed and a list of recommended spare parts.
 5. Generic or typical owner's instruction and operation manual shall not be acceptable to fulfill this requirement.
 6. 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 system from the original approved shop drawings.
 7. As-built Drawings shall include cable pathways; device locations with correct labeling, control equipment locations, remote power supply locations, cross connect locations, and lightning protection locations. The as-built drawings shall be prepared using AutoCAD 2014 or later.
 8. 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.
 9. A copy of the manufacturer's warranty on the installed system.
 10. Any keys to cabinets and/or equipment and special maintenance tools required

- to repair, maintain, or service the system.
11. 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)
 12. 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. Provide a video copy of the training session as well as all sign in and training sign off sheets
 13. One (1) 30" x 42" laminated floor plan sheets illustrating device locations, system wiring configuration, and cable designation. The System Installer shall provide one complete floor plan sheet at each panel location.

1.6 DEFINITIONS

A. Abbreviations:

1. ACS Access Control System
2. VMS Video Management System
3. NVR Network Video Recorder
4. IDS Intrusion Detection System
5. GUI Graphical User Interface
6. IP Internet Protocol
7. CR Card Reader
8. DS Door Station
9. MS Master Station
10. PIR Passive Infrared Sensor
11. LD Lockdown
13. LO Lockout
14. MDF Main Distribution Frame
15. IDF Intermediate Distribution Frame

B. Definitions:

1. Access Card: A coded employee card, usually the size of a credit card, recognizable to the access control system and read by a reader to allow access. It can be used for photo identification of the cardholder and for other data collection purposes. Card technologies include magnetic strips, Wiegand-effect, proximity (active/passive), barium ferrite, smart/intelligent cards, and NFC enabled applications on mobile devices.
2. Access Control System: An interconnected set of controllers, managing the entrance and exit of people through secured areas.
3. Access Level: The door or combination of doors and/or barriers an individual is authorized to pass through and the times they are permitted.
4. Anti-Pass back (Anti-Tailgating): This feature protects against more than one person using the same card or number. It defines each system card reader and card ID number as IN, OUT or other. Once a card is granted access to an IN reader, it must be presented to an OUT reader before another IN reader access is granted. Cards will continue to have access to all authorized OTHER readers.
5. Alarm: A signal that indicates a problem.
6. Alarm input: A device that is monitored by the access control panel. An alarm signal will be generated if the device is activated.
7. Badge: Badge is a template or a design for creating a card. DNA Fusion includes a full-featured badge layout utility for designing, creating, and printing badges. Badge design includes magnetic stripe encoding, bar coding, signatures, and so on.

8. Bar Code: A method of encoding information using lines and blank spaces of varying size and thickness to represent alphanumeric characters.
9. Biometrics: A general term for the verification of individuals using unique biological characteristics (i.e. fingerprints, hand geometry, voice analysis, the retinal pattern in the eye).
10. Card and Card Holder: A card is an identity proof of a person and a card holder is a person who holds the card. Multiple cards can be assigned to a single card holder to provide different access.
11. Controller: A microprocessor-based circuit board that manages access to a secured area. The controller receives information that it uses to determine through which doors and at what times cardholders are granted access to secure areas. Based on that information, the controller can lock/unlock doors, sound alarms, and communicate status to a host computer.
12. Card Reader: A device that retrieves information stored on an access card and transmits that information to a controller.
13. Digital Video Recorder: A security system device that records the video from the surveillance cameras (IP and Analog) on a hard disk.
14. Door: A generic term for a securable entry way. In many access control applications, a "door" may be a gate, turnstile, elevator door, or similar device.
15. Duress: Forcing a person to provide access to a secure area against that person's wishes.
16. Input: An electronic sensor on a controller that detects a change of state in a device outside the controller.
17. Integrated lockset: An integrated, intelligent locking solution that typically runs on batteries, but can be externally powered, that contains most of the door components, i.e. reader, door contact, and request to exit in a single, mountable unit.
18. Keypad: An alphanumeric grid which allows a user to enter an identification code. A flat device which has buttons that may be pressed in a sequence to send data to a controller, and which differs from a typewriter-like computer keyboard.
19. Output Relay: A device that changes its state upon receiving a signal from a controller. Typically, the state change prompts an action outside of the controller such as activating or deactivating a device. The auxiliary relays found in access control panels or NODES that control external devices.
20. Shunt Time: The length of time a door open alarm is suppressed (shunted) after a valid card access or free egress request. This time should be just enough to allow a card user to open a door or gate, pass through, and then close it.
21. Time Schedules: Schedules that allow cards to function or not function depending on the time of day. This is used to limit access to the facility. The schedule may include not only time but which days of the week a card is valid.
22. Video Management System: An enterprise-class video management and storage solution

1.7 PRE-INSTALLATION MEETINGS

- A. No less than a minimum of two weeks prior to rough-in or installation of any access control device, the ACS Installer will be required to attend a pre-construction meeting with the Door Hardware provider / installer to aid in coordination and help avoid gap / overlap during the installation phase.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store products in manufacturer's unopened packaging bearing the brand name and manufacturer's identification until ready for installation.

- B. Handling: Handle materials to avoid damage.

1.9 PROJECT 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 recommended limits.

1.10 SEQUENCING

- A. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

1.11 WARRANTY

- A. The ACS furnished by the System Integrator including wiring, software, hardware and third-party products shall be fully warranted for parts, materials and labor for a minimum of 1 year from date of the final acceptance.
- B. Manufacturer shall provide a limited 3-year warranty for the product to be free of defects in material and workmanship.

PART 2 - PRODUCTS

- 2.1 Reference Attachment 'A' of this specification for supplemental scope and product material list as it relates to the project and the Owner standards

2.2 MANUFACTURERS

- A. Approved Manufacturers:
 - 1. AMAG Technology Inc.
20701 Manhattan Place
Torrance, Ca 90501
(310).518.2380
<http://www.amag.com>
- B. Requests for substitutions will be considered in accordance with provisions of Division 1. In the absence of direction by Division 1, substitution request must be submitted no less than ten (1) business days from the time of proposal. Any substitution proposed will have to be proposed as a complete system replacement across the Owner's entire platform, including any cabling and/or hardware changes required to convert all of the Owner's existing sites.

2.3 SERVERS AND USER INTERFACE

- A. Servers and Unser Interfaces are existing to remain. The system installer shall coordinate the installation of all new equipment and/or existing equipment that is affected by the project's scope. All equipment shall be modified and/or added in compliance with the existing systems parameters. The system installed shall provide and additional equipment to furnish a complete expansion of the system as shown on the project drawings, access control schedule, details, and legends.

2.4 ACCESS CONTROL SYSTEM (ACS)

- A. General: The ACS is a modular and networked based system providing physical access

ACCESS CONTROL SYSTEM (ACS)

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control security to a Wide Area campus enterprise. The system shall be capable of controlling and integrating multiple security functions including the configuration, management and monitoring of cardholder access, locking hardware units, events, alarms, visitors, and real-time tracking and reporting. The ACS is to be alterable at any time depending on the facility requirements and will allow for easy upgradeability or modification of network processors, controller, interface modules, card data, inputs, outputs, and remote workstations. The ACS shall include, but is not be limited to, the following:

1. Client/Server model operating central server host software modules and client workstation software applications in a multi-user and a multi-tasking environment.
 - a. The ACS to permit multiple instances of client software applications to run simultaneously on the network. The base system shall include one (1) software application licenses per site with an unlimited number of licenses available subject to connection fees.
2. Partitioning: The system to support security partitioning enabling system administrator to segment the configuration database and group multiple entities within the security partition.
 - a. Security partitions limit what users can view in the configuration database. Administrators, who have all rights and privileges, can segment a database into multiple security partitions. A user who is given access to a specific partition will only be able to view entities (components) within the partition they have been assigned.
3. Encryption: The system to support encrypted communication between the central server software and client software applications (server-to-server and client-to-server) using a 128-bit AES encryption algorithm (at a minimum).
 - a. Communication between the central server host software module and system controllers to be encrypted if supported by the controllers.
 - b. The ACS client software applications to be password protected with passwords stored in the central server database in an encrypted manner.
4. Distributed Processing: The system is a fully distributed processing application allowing information, including time, date, zones, valid codes, tasks, access levels, and similar data, to be downloaded from the central host station to controller interface devices allowing access-control decisions with or without central host station communication. If communications to a central host station are lost, the controllers will automatically buffer event transactions until communications are restored and events are automatically uploaded to the central host station.
 - a. Provide for a higher level of distributed database management at defined perimeter access points such that no single point of failure will allow more than two access points to fail, or affect more than two access points at perimeter points system wide.
5. Single Data Base: The system to support a single database for access control site setup, credential and identity file creation, alarm and control setup, and system user operation and command functions.
6. System Access Management: The system to allow operators through password authentication the ability to make access granted or denied decisions, define access levels, time zones, holidays, assign cardholders, access groups, develop tasks, and generally manage access control, alarm monitoring and response activities system wide from a single login. Operator and user privileges are managed by a system administrator allowing for different levels of system access and system control. Authorization management is fully Owner definable.
7. Cardholder Management: The system to include a cardholder management system integrated within the access control system. This cardholder management functionality allows the enrollment of cardholders into the database, and import / export of employee data.

8. Access Groups and Access Levels: The system to provide adequate access groups and access level assignment capability to meet Owner requirements for the specified project. If required, software application can be expandable to support unlimited access groups and access levels.
 9. Alarm Monitoring: The system is able to monitor, report, and provide information about the time and location of alarms, along with their priority.
 10. Event Monitoring: The system is able to monitor, report, and archive network access control activity.
 11. Transaction Logs: The system to support an unlimited number of logs and historical transactions (events and alarms) with the maximum allowed being limited by the amount of hard disk space available.
 12. System Monitoring: The system to have ability to report on the integrity of all network assigned devices, circuits and communications and provide a diagnostics screen showing field level communications system wide
 13. Lock/Unlock Commands: The system to allow an operator to manually lock and unlock doors overriding scheduled access control restrictions and configurations if necessary.
 14. Hardware Interface: The system to integrate with and control specified electrified hardware, signaling and monitoring devices.
 15. Report Generator: The system to have the ability to generate and output reports with any and all combinations of system fields and data including, but not limited to: by cardholder, by door, by site, by time, by groups of doors and by cardholder field. Any and all combinations of fields must be available for reporting. The report feature to allow exporting of generated reports over a network connection or by remote printing.
 16. Multi-User/Web Based Network Capabilities: The system to support multiple operator workstations via local area network/wide area network (LAN/WAN), the Internet, or VPN. The system to be capable of supporting minimum of concurrent users/clients with software expansions to an unlimited number of workstations based on the Owners network requirements.
- B. Open Protocol: The ACS manufacturer to provide non-proprietary, open protocol hardware for the system control processors and associated device sub-controllers. Systems utilizing a single manufacturer solution that encompasses combined proprietary software and integrated electronic hardware combinations are not acceptable. In addition, integrated electronic locking hardware requiring a processor or sub-controller module upgrade, or extensive access control firmware upgrades to accommodate integrating with an alternate software package, will not be considered.
- C. Network Support: Communication network connecting the central server host software modules, client workstation software applications, and hardware controllers to be designed to support all of the following:
1. LAN/Ethernet enterprise ring topology and localized star topology based on TCP/IP.
 2. Direct-connected RS-232 and RS-485 communication cabling.
 3. Dial-up modem connection using a standard dial-up telephone line.
- D. Provide local communication port at each panel for local configuration of system with laptop.
- E. Locate all main control panels in MDF and IDF rooms of each building.
- F. Provide 120v at all controller and power supply locations.
- G. Provide and transfer all required licensing to the owner.

- H. Provide local communication port at each panel for local configuration of system with laptop.
- I. Integrated Elevator Destination Dispatch Control Solutions
 - 1. The ACS shall provide means of integration with the following elevator systems destination dispatch control solution. Integration shall be by software or input/output connection (software, if available between the specified ASC and Elevator System):
 - a. Otis
 - b. Krone
 - c. Thyssen-Krupp
 - 2. The destination dispatch control solution shall provide the following functions:
 - a. Provide card reader security within the elevator(s) as required.
 - b. Provide card reader security at the Destination Dispatch kiosk(s), as required.
 - c. Allow Default Floor call registration upon card swipe.
 - d. Allow for card flags such as VIP and ADA from a card swipe
 - e. Enforce elevator access levels

2.5 ACCESS CONTROL PANEL HARDWARE

- A. Reference Attachment 'A'
- B. System Back-Up Battery: The System Installer shall provide backup batteries as required to furnish ninety (90) minutes of run time to the complete system, including but not limited to lock power and system power.

2.6 FIELD DEVICES

- A. General: Coordinate with door hardware and access control schedule as to whether each access control portal is wireless or directly connected to a control panel. Provide all Controllers, Sub-Controllers, and licensing as required to connect all card reader locations shown on plan.
- B. Card Readers: Provide card readers as shown on the floor plans, access control schedule, and access control details.
- C. Credentials: Coordinate Facility Code, External Start Number, and Internal Start number with the Owner prior to procuring credentials.
- D. Miscellaneous Devices: Provide the following devices as designated per the project floor plans, access control schedules, and access control details:
 - 1. DP/DT Door Position Sensors (Door Contacts)
 - 2. PIR Motion Request to Exit Sensor
 - 3. Lockdown Buttons
 - 4. Door Release Buttons
 - 5. Video Intercom Door Stations (Provide and Install per drawings and Division 28 Audio / Video Intercom specification)
 - 6. Video Intercom Master Stations (Provide and Install per drawings and Division 28 Audio / Video Intercom specification)

2.7 WIRING

- A. All cable associated with the ACS shall be purple in color.

- B. Ethernet cabling to access control panels shall be as specified in the Structured Cabling System (SCS) specifications and shall be provided by the SCS Installer. In the event that there is not SCS installer on the project, cabling shall be provided and installed by the ACS Installer and shall comply with the Division 27 SCS specification, minimum of Category 6A cable shall be utilized if not specified otherwise.
- C. Provide cabling and connections for all access control doors in this scope, existing and new. Conventional access control cable shall be a jacketed composite cable. The minimum conductor requirement shall be as follows:
 - 1. Standard
 - a. Lock Power: 4-conductor, 18AWG, shielded
 - b. Card Reader: 6-conductor, 22AWG, OA shielded
 - c. Door Contact: 2-conductor, 22AWG, shielded
 - d. Request to Exit/Spare: 4-conductor, 22AWG, shielded
 - 2. Extended Distance
 - a. Lock Power: 4-conductor, 16AWG, shielded
 - b. Card Reader: 6-conductor, 18AWG, OA shielded
 - c. Door Contact: 2-conductor, 18AWG, shielded
 - d. Request to Exit/Spare: 4-conductor, 18AWG, shielded
- D. Wire scheme and conductor quantity shall be as required by the manufacture's specifications. The System Installer to provide and install shielded cable as required.
- E. All 120v Power shall be furnished by the Division 26 contractor. In the event that a division 26 contractor is not contracted for the project, the system installer shall contract a licensed electrical firm to provide and install all materials required to furnish a complete and operational system.
- F. All Security Conduit as required for a complete installation of this system shall be furnished by the division 26 contractor as part of their scope of work. In the event that a division 26 contractor is not contracted for the project, the system installer shall provide and install all conduit required.
- G. Coordination with the Division 26 contractor is the responsibility of the ACS Installer to ensure all conduit is in place for a complete installation.
- H. All systems shall be connected to a dedicated circuit and on an emergency power source if available.

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. Network Connection Cable: Provide a 4 pair Category 6A data cable from the Master Control Panel to the MDF network rack. Category 6A cable shall be purple in color.
- I. 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.
- J. System Installer is required to provide all mapping and software configuration required to operate system as per manufacturer's recommendations.

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:
 - 1) Panduit
 - 2) Arlington
 - 3) Caddy
 - 4) Support system shall be 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 system installer shall provide a dedicated threaded rod extending within 5' of the finished ceiling and mount the cable support hook to the treaded rod.
 - 3. The cable support shall be installed at a maximum of 5' on center.
 - 4. All cable installed shall be attached to the cable 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 control 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 system installer 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.

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.
5. All conduit ends shall have a protective bushing to prevent cable damage. Bushings must be installed prior to installing cable. Cutting bushing to install around installed cables will not be accepted.

3.3 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 and the project's Technology Consultant 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.

3.4 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.

3.5 SOFTWARE

- A. Provide two electronic copies of the final programming and program software to the Owner's Security Supervisor after final approval.

ATTACHMENT 'A'

PROJECT SPECIFIC SCOPE OF WORK AND EQUIPMENT LIST

PART 1 – PROJECT SCOPE

1.1 DESCRIPTION OF WORK

- A. This project is an expansion of an existing access control system and consists of the provision and installation of a complete and functional Access Control System (ACS) as required to furnish controlled access and access detection to all controlled portals identified on the project drawings. This project is an elementary school renovation for the Cypress-Fairbanks Independent School District.
- B. It should not be assumed that any portions of a complete and functional system are to be furnished and/or provided by anyone, other than the ACS installer, unless specifically stated otherwise.

PART 2 – EQUIPMENT LIST

- 2.1 The ACS installer shall perform no portion of the work requiring submittal and review of record drawings, shop drawings, product data, or samples until the respective documentation has been approved by project's Security Consultant.

2.2 VESTIBULE ACCESS CONTROL PANEL

- A. All hardware is to be mounted in an Altronix Trove 2 enclosure with RSB2 switch plate located in the nearest IDF to the main entry vestibule.
- B. One (1) Intelligent Door Controller and door SubControllers shall be populated in the Altronix enclosure sufficient to provide access controls for all doors to be controlled from the IDF, for a minimum of eight (8) doors. The Intelligent Controller shall be IP-based. SubControllers should connect to the Intelligent Controller via network or RS-485 Data Bus.
- C. An Altronix eFlow 10XNB power supply is required to be provided and installed along with a PDS8CB or PD16W Power Distribution Module and ACM8CB Access Power Controller. A (1) VR6 regulator in the enclosure to provide correct power distribution.
- D. Panel must have a provided emergency power circuit to the R2B2 switch panel to enable ease of power shut off for the power supply by one switch and main panel transformer on the secondary switch.
- E. Two Category 6A network drops are required within the panel for local configuration of system with laptop and primary panel communication. Each drop should be properly labeled per network cabling guidelines.
- F. Panel IP network configuration information shall be provided by the owner.
- G. All vestibule doors are to be wired back to this main panel with approved composite access control cable and terminated in the following order
 1. Front Entry Door- Reader 1 -24VDC/12VDC output 1
 2. Reception Entry Door- Reader 2 -24VDC/12VDC output 2
 3. Vestibule Exit Door- Reader 3 -24VDC/12VDC output 3
 4. Reception Exit Door- Reader 4 -24VDC/12VDC output 4
- H. Final software configuration / programming of system integration will require owner and system installer consultation.
- I. Vestibule Access Control Panel shall not be limited to provide access control power and controllers to the vestibule only, but shall be available for other controlled doors in the area of influence of that IDF.

2.3 PERIMETER AND INTERIOR DOOR CONTROL PANELS

- A. Door Control Panels are to be installed as needed in MDF/IDF rooms throughout the campus, to provide communications and power for access control devices in the area of influence of each IDF.
- B. All hardware is to be mounted in an Altronix Trove 2 enclosure with RSB2 switch plate. Panel must have a provided emergency power circuit to the RB2 switch panel to enable ease of power shut off for the power supply by one switch and main panel transformer on the secondary switch.
- C. One (1) Intelligent Door Controller and door SubControllers shall be populated in the Altronix enclosure sufficient to provide access controls for all doors to be controlled from the IDF, for a minimum eight (8) doors. The Intelligent Controller shall be IP-based. SubControllers should connect to the Intelligent Controller via network or RS-485 Data Bus.
- D. An Altronix eFlow 10xNB power supply is required to be provided and installed along with a PDS8CB or PD16W Power Distribution Module and ACM8CB Access Power Controller. A (1) VR6 regulator in the enclosure to provide correct power distribution.
- E. Two Category 6 network drops are required within the panel for local configuration of system with laptop and primary panel communication. Each drop should be properly labeled per network cabling guidelines.
- F. Panel IP network configuration information shall be provided by the owner.
- G. Final software configuration / programming of the system integration will require owner / contractor consultation.

2.4 VEHICLE ACCESS GATES

- A. Access Controlled gates shall be connected to an IP-based 2-Door controller which may be installed near the building perimeter wall, closest to the gate, to provide additional cabling distance.
- B. 2N IP Verso Video Intercom (w/ Wiegand and Prox Reader module) to be installed on pedestal housing for access control entry through controlled vehicle gate.
- C. All gates must have a Tagmaster XT-1 RFID reader installed as the secondary for utilization of district vehicle tag system.
- D. Consultation is required with the owner to determine is additional Vehicle Tags will be required at the time of installation and the amounts needed.

2.5 FIELD DEVICES

- A. Card Access Equipment
 - 1. All Card Readers locations to be installed on walls or pedestrian gates shall be PR10 card readers as manufactured Schlage.
 - 2. All Card Readers locations to be installed on doors shall be Harmony series readers as manufactured by Sargent.
 - 3. Access Control contractor shall provide ALL electronic components required for a complete and functioning access control system, to include card reader, door contact, lock power supply, electrified locking device with integrated request to exit, power transfer hinge and wiring harnesses. The door hardware contractor shall be responsible for non-electrified, mechanical door hardware.
 - 4. Access Control contractor shall provide all cabling required for connection to any

- device incorporated and not incorporated in door hardware.
5. Contractor shall provide 300 HID proximity cards 1386 Series for this campus. CFISD has a Corporate 1000 account set up with HID. The contractor shall purchase cards through HID using this account to ensure card numbers and facility numbers are followed.
 6. Provide Ethernet Network Interface to connect school to district-wide access control system. Connect to local area network at each facility.
 7. Contractor shall provide all cabling and accessories required to provide complete access control solution and proper integration with building intrusion alarm system for door contact shunting.
 8. Provide all door controllers as required to connect all perimeter card reader locations shown on plan plus one additional of each type for attic stock.

2.6 WIRING

- A. Access Control Contractor shall provide and install Access Control system cabling.
 1. Color code of all security intrusion detection system an access control wiring shall be purple in color.
Approved products: Lake Composite Access Control Cable: S800081709-07
 2. Reference Specification Section 27 10 00 Technical Cabling and Section 28 16 00 Intrusion Detection for cable types.
 3. All systems shall be connected to an emergency power source as available.
 4. All 120v Power and system conduits as shown on the drawings shall be furnished by a licensed electrical contractor as part of their scope of work.
 5. Coordination with the electrical contractor is the responsibility of the Security contractor to ensure all conduit is in place for a complete installation.

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 provides 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 traversing the respective box as well as the number of terminations required.

- H. Network Connection Cable: Provide a Category 6 data cable from the Master Control Panel/Node to the MDF network rack. Category 6 cable shall be purple in color.
- I. 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 Velcro ties and J-Hooks. (Ref. 28-13-00 3.3A)
- J. Contractor is required to provide all mapping and software configuration required to operate system as per manufacturer's recommendations.

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 ® Corporate J-MOD TM 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 TM support hook to the threaded rod.
 - 3. J-MOD TM cable support shall be installed at a maximum of 5' on center.
 - 4. All cable installed shall be attached to the J-MOD TM support system with plenum rated Velcro and a plenum rated Velcro tie shall be installed between each J-MOD TM cable support to keep wires neatly bundled throughout the entire run. Tiewraps will only be allowed to be used inside the control 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 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.
- 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 the 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.
5. All conduit ends shall have a protective bushing to prevent cable damage. BUSHINGS MUST BE INSTALLED PRIOR TO INSTALLING CABLE. CUTTING BUSHING TO INSTALL AROUND INSTALLED CABLES WILL NOT BE ACCEPTED.

3.3 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, Door Hardware Installer, 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 the system, for the Owner's designated personnel.

3.4 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. Installed main system devices must be awarded the same warranty provided to the installer by the Manufacturer of the product.

3.5 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 10 00.05 - AUDIO / VIDEO INTERCOM (IP)

PART 1 - GENERAL

1.1 RELATED WORK

- A. The following, in their entirety and as applicable, shall apply to this section. Including any associated drawings.
 - 1. Conditions of the Contract
 - 2. Division 1
 - 3. Division 26
 - 4. Division 27
 - 5. Division 28

1.2 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 14001.
 - 2. The specified unit shall be compliant with the EU directives 2011/65/EU (RoHS) and 2012/19/EU (WEEE).
 - 3. The specified unit shall be compliant with the EU regulation 1907/2006 (REACH).

1.3 CERTIFICATIONS AND STANDARDS

- A. General abbreviations and acronyms
 - 1. AES: Advanced Encryption Standard
 - 2. API: Application Programming Interface
 - 3. Bit Rate: The number of bits/time unit sent over a network
 - 4. DHCP: Dynamic Host Configuration Protocol
 - 5. DNS: Domain Name System
 - 6. FPS: Frames per Second
 - 7. FTP: File Transfer Protocol
 - 8. H.264 (Video Compression Format)
 - 9. IEEE 802.1x: Authentication framework for network devices
 - 10. IP: Internet Protocol
 - 11. IR light: Infrared light
 - 12. ISO: International Standards Organization
 - 13. JPEG: Joint Photographic Experts Group (image format)
 - 14. LAN: Local Area Network
 - 15. LED: Light Emitting Diode
 - 16. MPEG: Moving Picture Experts Group
 - 17. Multicast: Communication between a single sender and multiple receivers on a network
 - 18. NTP: Network Time Protocol
 - 19. ONVIF: Global standard for the interface of IP-based physical security products
 - 20. PACS: Physical Access Control System
 - 21. PoE: Power over Ethernet (IEEE 802.3af/at) standard for providing power over network cable
 - 22. Progressive scan: An image scanning technology which scans the entire picture
 - 23. QoS: Quality of Service

24. RPC: Remote Procedure Call
25. SIP: Session Initiation Protocol
26. SMTP: Simple Mail Transfer Protocol
27. SNMP: Simple Network Management Protocol
28. SSL: Secure Sockets Layer
29. TCP: Transmission Control Protocol
30. TLS: Transport Layer Security
31. Unicast: Communication between a single sender and single receiver on a network
32. UPS: Uninterruptible Power Supply
33. VBR: Variable Bit Rate
34. VMS: Video Management System
35. WDR: Wide dynamic range

B. The specified unit shall carry the following EMC approvals:

1. EN55032: 2012
2. EN55024: 2010
3. 2014/35/EU
4. 2014/30/EU
5. 2012/19/EU
6. 2011/65/EU
7. EN 55032 Class A
8. EN 55032 Class B
9. EN 55024
10. FCC Part 15 - Subpart B Class A
11. FCC Part 15 - Subpart B Class B
12. FCC Part 15 - Subpart B Class A + B
13. ICES-003 Class A
14. ICES-003 Class B

C. The specified unit shall meet the following product safety standards:

1. IEC/EN/UL 60950-1

D. The specified unit shall meet the following standards

1. Audio:
 - a. G.711
 - b. G.729
 - c. G.722 (wideband)
 - d. L16 / 16kHz (wideband)
2. Video:
 - a. H.263+
 - b. H.263
 - c. H.264 (MPEG-4 AVC)
 - d. MPEG-4 Part 2
 - e. MJPEG
3. Networking:
 - a. IEEE 802.3af/802.3at (Power over Ethernet) [applies to products with PoE]
 - b. IEEE 802.1X (Authentication)
 - c. IPv4 (RFC 791)
 - d. QoS
4. Mechanical Environment:
 - a. IEC/EN 60529 IP54
 - b. IEC/EN 62262 IK08

1.4 QUALITY ASSURANCE

A. Contractor Qualifications:

1. The system installer shall be the authorized representative of the manufacturer to sell, install, and service the proposed manufacturer's equipment. The system installer shall have represented the security alarm manufacturer's product for a minimum of five (5) years' with experience installing and servicing systems of similar scope and complexity and evidence that is completed at least three (3) projects of similar design and is currently engaged in the installation and maintenance of systems herein described.
2. The system installer shall be licensed as required, by the State in which the project is located in, as a security services contractor to design, sell, install, and service security alarm systems.
3. The system installer shall provide 24-hour, 365 days per year emergency service with factory trained service technicians.
4. The installing firm shall have personnel on their staff that has been actively engaged in the business of designing, selling, installing, and servicing security systems for at least ten (10) years.
5. The proposing contractor for this system and the installing contractor of this system shall be of the same organization. Absolutely no subcontracting of any portion of this system by the proposing contractor will be allowed.
6. The proposing/installing contractor of this system must be an authorized dealer / integrator for the project's specified Access Control, Video Surveillance and the Intrusion Detection systems as well as the system specified in this section.
7. Contractor must be a current integrator of solution in the closest major metropolitan area marketplace, have a permanent office located within 75-miles of the project, and be able to include information on current support staff to be able to service this client.
8. 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.
9. The system installer shall submit credentials of completed manufacturer certification, verified by a third-party organization, as proof of the knowledge.
10. The Contractor shall provide four (4) current references from clients with systems of similar scope and complexity that became operational in the past three (3) years. At least three (3) of the references shall be utilizing the same system components, in a similar configuration as the proposed system
11. Contractor must be in good standing with the Owner and have no outstanding performance or warranty items at the time of bid. Any outstanding items or issues is grounds to disqualify the Contractor for performing any work on the project.

B. System Qualifications:

1. The specified unit shall be manufactured in accordance with ISO9001.

1.5 SUBMITTALS AND CLOSE-OUT

A. Product Data:

1. Within fourteen (14) days of Notice to Proceed, the 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 system equipment, power supplies, cable, termination components, cable supports, cable labels, field 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 submitted.

- c. Construction Schedule: A time-scaled Construction Schedule indicating general project deadlines and specific dates relating to the installation of the cable distribution system.
- d. Specification Compliance: A letter shall be provided stating, by section and subsection, that the 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. 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) Manufacturer's Authorized Dealer/Installer Certification: This certification must be held by the proposing/installing contractor and state that the proposing/installing contractor is and authorized dealer/installer of the system specified within the project specifications. The certification must have been obtained by the office that is within a 75-mile radius of the project's location.
 - 2) 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.
 - 3) Licenses: This includes all licenses required by the state in which the work is being performed, the federal government, local authorities having jurisdiction, and any organization in that governs the specific system

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 system registered designer. The designer's certification must be current. Identifiable, separate routing shall be shown for both the station cabling and any backbone trunk 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 all control equipment and remote power sources
 - 2) Locations of all field devices and outlets
 - 3) Location of wall penetrations (all penetrations shall be sleeved and contain protective bushings at both ends)
 - 4) Location of sleeved wall and/or floor pass-thru
 - 5) Size of sleeve at each location installed
 - 6) Quantity of cable passing through each sleeve
 - 7) Conduit routing, size, quantity, and stub-up locations for any floor mounted outlets or outlets installed in casework.

- c. Drawing Compliance: A letter shall be provided stating that the 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 approved by the project's technology consultant.
- C. Close-out Procedures: For review and acceptance, furnish an electronic copy of the following documents to the Architect / Engineer. Upon acceptance of the submitted close-out documents, provide four (4) copies on an electronic storage media (CD or USD Flash Drive) Labeled with the project name, date of submission, and the name of the submitting firm. Final copies shall be delivered directly to the project's Technology Consultant. The closeout submittals shall include the following and be packaged in a storable container with the physical storage media and any physical items listed:
1. 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.
 2. Provide complete test reports for all cabling and devices that comprise system as outlined in this document.
 3. Include the Name, address and telephone of the authorized factory representative with a 24-hour emergency service number.
 4. The manual shall also include Manufacturer's data sheets and installation manuals/instructions for all equipment installed and a list of recommended spare parts.
 5. Generic or typical owner's instruction and operation manual shall not be acceptable to fulfil this requirement.
 6. 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 system from the original approved shop drawings.
 7. As-built Drawings shall include cable pathways; device locations with correct labeling, control equipment locations, remote power supply locations, cross connect locations, and lightning protection locations. The as-built drawings shall be prepared using AutoCAD 2014 or later.
 8. 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.
 9. A copy of the manufacturer's warranty on the installed system.
 10. Any keys to cabinets and/or equipment and special maintenance tools required to repair, maintain, or service the system.
 11. 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 labelled with the project name and description. (4 copies)
 12. 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. Provide a video copy of the training session as well as all sign in and training sign off sheets
 13. One (1) 30" x 42" laminated floor plan sheets illustrating device locations, system

wiring configuration, and cable designation. Contractor shall provide one complete floor plan sheet at each panel location.

1.6 WARRANTY

- A. All security system components and labor furnished by the contractor including wiring, software, hardware and custom parts shall be fully warranted for parts, materials, labor and travel expenses for a minimum of three (3) years start from the date of substantial completion.
- B. The manufacturer shall provide warranty and optional extended warranty for the unit for a total period of maximum five years. If enacted as part of the contract, the contractor will repair or replace parts and/or labor per the warranty for the length of this warranty at no cost to the client.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Intercoms shall be IP-based and comply with established network and video standards.
- B. Intercoms shall be powered by the switch utilizing the network cable.
- C. Intercoms 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.

2.2 INTERCOM SCHEDULE

- A. Intercom types listed below describing various resolutions, form-factor and features shall be supplied by a single intercom manufacturer.
- B. The intercom manufacture and model numbers will be as follows:
 - 1. Modular IP intercom shall be 2N IP Verso with camera. Part # 02907-001
 - 2. IP intercom base station shall be 2N Indoor View. Part # 02088-001
 - a. 2N Base station stand required. Part # 02039-001
 - 3. 2N Combo Reader Module. Part # 016939-001
 - 4. 2N Secure Door Set Tamper. Part # 01975-001
 - 5. 2N Weigand Module. Part # 01259-001
 - 6. 2N Surface frame plate. Part # 01289-001
 - 7. 2N Surface back plate. Part # 01294-001

2.3 INTERCOM

- A. Modular IP intercom
 - 1. The intercom shall meet or exceed the following design specifications:
 - a. Intercom shall include a built-in web server.
 - b. Intercom shall be able to perform defined local access control functionality without being connected to the network.
 - c. Intercom shall be of modular design, include a replaceable front-end frame, providing 1 or 2 additional slots for functional modules, and should support multiple frames stacked side by side. The intercom shall support at least 29 functional modules when fully expanded.
 - d. Intercoms' main unit shall be available with and without camera, and shall support the following functional modules:

- 1) ID card reader
- 2) Fingerprint reader
- 3) Keypad
- 4) Button module
- 5) Touch screen
- 6) Bluetooth
- 7) Wiegand interface
- e. The intercom shall be equipped with an IR-sensitive progressive scan megapixel sensor and be able to provide images also under dark conditions.
- f. The intercom shall be equipped with built-in power adaptive IR-illumination/LED.
- g. The camera shall provide an automatic IR-cut filter, providing day/night functionality.
2. The intercom shall meet or exceed the following performance specifications:
 - a. Video
 - 1) The intercom shall provide video streams in 640x480 at up to 30 frames per second using H.264, H.263, H.263+ or up to 15 frames per second using MJPEG.
 - 2) The intercom camera shall provide images in resolutions up to 1280x960.
 - 3) The intercom shall support the following video encoding algorithms:
 - a) H.263+
 - b) H.263
 - c) H.264
 - d) MPEG-4 Part 2
 - e) MJPEG
 - 4) The intercom shall provide independently configured simultaneous H.264 and MJPEG streams.
 - 5) The intercom shall in H.263, H.263+, H.264 support Constant Bit Rate (CBR) to protect the network from unexpected bit rate peaks.
 - 6) The intercom shall provide configurable compression levels.
 - 7) Support standard baseline profile H.264 with motion estimation.
 - 8) Support motion estimation in H.264/MPEG-4 Part 10/AVC.
 - 9) The intercom shall allow for video to be transported over:
 - a) HTTP (Unicast)
 - b) HTTPS (Unicast)
 - c) RTP (Unicast & Multicast)
 - d) RTP over RTSP (Unicast)
 - e) RTP over RTSP over HTTP (Unicast)
 - 10) The intercom shall support Quality of Service (QoS) to be able to prioritize traffic.
 - b. Image
 - 1) The camera shall incorporate automatic white balance.
 - 2) The camera shall support manually defined values for:
 - a) Color level
 - b) Brightness
 - c. Audio
 - 1) The intercom shall support two-way full duplex audio:
 - a) Input sources
 - (1) Internal microphone
 - b) Output sources
 - (1) Built-in speaker, 2W

- (2) Line out
 - 2) The intercom shall support separately adjustable volume levels for:
 - a) Call
 - b) Key
 - c) Ring tones
 - d) Preloaded audio clips
 - e) Warning tones
 - f) Paging
 - 3) The intercom shall support adaptive gain control.
 - 4) Encoding
 - a) The intercom shall support:
 - (1) G.711
 - (2) G.722 (wideband)
 - (3) G.729
 - (4) L16 / 16kHz (wideband)
 - 5) The intercom shall provide a sound pressure level of at least 78dB at 1kHz at 1m.
 - 6) The intercom shall be equipped with active echo cancellation.
 - 7) The intercom shall allow for audio to be transported over:
 - a) RTP (Unicast & Multicast)
 - b) RTP over RTSP (Unicast)
 - c) RTP over RTSP over HTTP (Unicast)
 - 8) The intercom shall support Quality of Service (QoS) to be able to prioritize traffic.
- d. Call functionality
- 1) The intercom shall support SIP for integration with VoIP, peer-to-peer or integrated into SIP/PBX.
 - 2. The intercom shall support the use of SIP Proxy, which can be the same as the SIP registrar for outgoing calls.
 - 3) The intercom shall support dialing up to twelve separate numbers in sequence or as ring group.
- e. Access control functionality
- 1) The intercoms' reader outputs shall be wired through the Weigand module to the existing access control system.
- f. User Interface
- 1) Web server
 - a) The intercom shall contain a built-in web server making functionality and configuration available to multiple clients in a standard operating system and browser environment using HTTP, without the need for additional software.
 - 2) IP addresses
 - a) The intercom shall be set with dynamically assigned IP addresses provided by a Dynamic Host Control Protocol (DHCP) server.
 - b) The intercom shall allow for automatic detection of the intercom based on WS Discovery when using a computer with an operating system supporting this feature.
 - c) The intercom shall provide support for IPv4.
- g. Event functionality
- 1) The intercom shall be equipped with an integrated event functionality, which can be triggered by:
 - a) Tamper / case open

- b) SIP Call state incl. incoming call
- c) Change of SIP registration status
- d) Video Motion Detection
- e) Noise Detection
- f) SIP DTMF sequences
- g) External input
- h) Access control events such as code, card, fingerprint entered
- i. Predefined time
- 2) Response to triggers shall include:
 - a) Send notification, using HTTP or email
 - b) Activate sound alarm
 - c) Make or end call
 - d) Send notification, using HTTP, HTTPS, Wiegand or email
 - e) Send images, using FTP or email
 - f) Activating external output
 - g) Play audio clip
- h. Protocol
 - 1) The intercom shall incorporate support for at least HTTP, HTTPS, SIP 2.0, TFTP, RTSP, RTP, SMTP, DHCP opt 66, NTP, Syslog.
 - 2) The SMTP implementation shall include support for SMTP authentication.
 - 3) The camera shall incorporate support for at least IPv4, HTTP, HTTPS, SIP, SSL/TLS, QoS Layer 3 DiffServ, TCP, ICMP, SNMPv2c, RTSP, RTP, UDP, IGMP, RTCP, SMTP, FTP, DHCP, ARP, DNS, NTP,
- i. Security
 - 1) The intercom shall support the use of HTTPS and SSL/TLS, providing the ability to upload signed certificates to encrypt and secure authentication and communication of both administration data and video streams.
 - 2) The intercom shall block its login page for 30 seconds after three faulty passwords have been submitted.
 - 3) The intercom shall force user to change admin password upon first installation.
 - 4) The intercom shall provide centralized certificate management, with the ability to upload CA certificates. The certificates shall be signed by an organization providing digital trust services.
 - 5) The intercom shall support IEEE 802.1X authentication.
 - 6) Selected services, such as RTSP or web config shall be configurable to only allow access from local devices.
 - 7) The intercom shall restrict access to the built-in web server by username and password.
 - 8) The intercom shall be equipped with tamper detection.
- j. API support:
 - 1) The intercom 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) The intercom shall conform to ONVIF profile S as defined by the ONVIF Organization.
 - a) For ONVIF profile specifications, see www.onvif.org/
 - 3) The intercom shall be interoperable/certified with major PBX and

- gateway manufacturers, including:
 - a) Cisco
 - b) Avaya
 - c) Broadsoft
- k. Installation and maintenance
 - 1) The intercom shall support secure configuration using HTTPS.
 - 2) The intercom shall support the use of SNMP-based management tools according to SNMP v2c.
 - 3) The intercom shall allow updates of the software (firmware) over the network, using TFTP, HTTP or web interface.
 - 4) The intercom shall be time synchronized to the district NTP (Network Time Protocol) server.
 - 5) The intercom shall support back-up and restore of configuration.
 - 6) The intercom shall store all customer-specific settings in a non-volatile memory that shall not be lost during power cuts or soft reset.
- l. Access log
 - 1) The intercom shall be able to log events such as codes, phone calls, RFID cards etc., and provide them using HTTP interface for monitoring.
 - 2) The administrator shall be able to set whether the particular messages are sent by the intercom immediately after any event occurs, or if the client registers for event logging and then asks for full report since last registration, all events at once.
 - 3) The client shall be able to select which messages are reported from event log.
- m. Intercom diagnostics
 - 1) The intercom shall be equipped with LEDs, capable of providing visible status information. LEDs shall indicate the intercom's operational status and provide information about power, the network status and the intercom status.
 - 2) The intercom shall be monitored by a Watchdog functionality, which shall automatically re-initiate processes or restart the unit if a malfunction is detected.
- n. Hardware interfaces
 - 1) Network interface
 - a) The intercom shall be equipped with one 10BASE-T/100BASE-TX Fast Ethernet-port, using a standard RJ45 connector and shall support auto negotiation of network speed (100 MBit/s and 10 MBit/s) and transfer mode (full and half duplex).
 - 2) Doors
 - a) The intercom shall be equipped with programmable input supporting both short circuit activation or up to +30VDC for door monitor or Request to Exit (REX).
 - b) The intercom shall be equipped with two independent outputs for door control. One active providing at least 8VDC / 400mA and one NO/NC relay supporting up to 30V AC/DC 1A.
 - 3) Audio
 - a) The intercom shall be equipped with line output.
 - 4) Power
 - a) The intercom shall be equipped with a removable terminal block providing connectivity for external power.
 - 5) Multifunctional connector

- a) The camera shall, by using a “multi wire ribbon cable”, provide connectivity between main unit and modules.
- o. Enclosure
 - 1) The intercom shall:
 - a) Be manufactured with IP54 rated housing, and be IK08 (IK07 when using Touchscreen module).
 - b) Be fitted with a tamper switch.
 - c) Be of modular design, supporting main unit and up to 29 additional modules.
 - d) Be available in black and brushed nickel versions.
- p. Power
 - 1) Power over Ethernet IEEE 802.3af/802.3at Type 1 Class 0
 - 2) 12 V DC
 - a) Max: 2A
- q. Environmental
 - 1) The intercom shall:
 - a) Operate in a temperature range of -40 °C to +60 °C (-40 °F to 140 °F)
 - b) Operate in a humidity range of 10–95% RH (non-condensing).

PART 3 - EXECUTION

3.1 INSTALLATION

- A. 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 complete system.
- B. All equipment shall be configured in accordance with instructions provided by the manufacturer and systems administrator prior to district inspection.
- C. All firmware found in products shall be the latest and most up-to-date provided by the manufacturer.
- D. The contractor shall provide a 2N Indoor Touch 2.0 master station at the primary operator’s desk with its appropriate stand.
- E. Contractor is responsible for working with other trades to ensure proper installation of all devices per recommended codes.
- F. All equipment requiring users to log on using a password shall be configured with district specific password. No system/product default passwords shall be allowed.

END OF SECTION

SECTION 28 20 00 - VIDEO SURVEILLANCE SYSTEM (VSS)

PART 1-GENERAL

1.1 RELATED WORK

- A. The following, in their entirety and as applicable, shall apply to this section. Including any associated drawings.
1. Conditions of the Contract
 2. Division 1
 3. Division 26
 4. Division 27
 5. Division 28

1.2 DESCRIPTION OF WORK

- A. Provide a complete and tested IP based digital video surveillance system (VSS) 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. Provide fully terminated unshielded twisted pair (UTP) cable, UTP terminations, racks, raceways, conduit, and other incidental and miscellaneous premises wiring system hardware as required for a complete and useable system. The installation shall comply with applicable codes and standards in effect at the job site and as indicated in the Specifications and Drawings.
- B. The system shall be Non-Proprietary in nature and be available through multiple distribution channels in the nearest metropolitan marketplace. Systems that are manufactured and installed by a factory office and are not available through multiple distribution channels will not be accepted.
- C. 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 in order to provide the Owner a substantially complete project in a timely manner.
- D. Acceptable manufacturers of NVR equipment shall be Seneca Data only. Contractor must be a current Exacq Enterprise Certified integrator of the solution in the Houston marketplace and be able to include information on current support staff to be able to service this client. Seneca NVR part numbers and configuration are listed in the specification to define equipment capabilities and requirements for this project.
- E. Contractor must be a current integrator of solution in the Houston marketplace and be able to include information on current support staff to be able to service this client as needed 24x7 for emergency support.
- F. Contractor shall provide a complete turnkey solution to the owner and be responsible for the complete installation of a security camera system.
- G. The contractor must be in good standing with the district and have no outstanding performance or warranty items at the time of bid. Any outstanding items or issues is grounds to disqualify the contractors bid.

- H. Project scope is the expansion of the existing system.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications:
1. The Video Surveillance System Installer shall be Exacq Enterprise certified and shall meet all applicable regulations. The Contractor shall be a firm normally employed in the security and surveillance industry.
 2. The contractor shall be certified by the manufacturing company in all aspects of design, installation and testing of the products described herein. Each contractor shall furnish with their submittal a letter from the manufacture 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. 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.

1.4 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: If the requirements of these specifications or the Project Drawings exceed those of the governing codes, regulations, and manufacturer installation requirements, 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.

1.5 SUBMITTALS

- A. Project Initiation: Within fourteen (14) days of Notice to Proceed, the data network 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 material, hardware, and equipment to be used in the installation of the specified system. 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
 3. Construction Schedule: A time-scaled Construction Schedule, indicating general project deadlines and specific dates relating to the installation of the cable distribution system.
 4. 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 approved by the Owner.
 5. Each Submittal must have a detailed parts list. Quantities will not be required as the quantity of any portion of this system shall be as required for a complete and functional system and in conjunction with the contract documents.
 6. Certifications: The contractor shall submit all certifications for approved products and the certifications 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.
 - a. Physical Security Professional (PSP) Certification: This certification must be held by an on-staff, full-time employee of the system installer. The holder must be staffed out of the office that is located within 75 miles of the projected.
 - b. Manufacturer Authorized Dealer Certification must be held by the system installer's office that is located within 75 miles of the project and shall be a company certification, not and individual certification.
 - c. Installer Certifications: Certification indicating that an individual has successfully completed installer training, issued by the VMS and Cameras Manufacturers specified herein, 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.

- B. Shop Drawings: Submit the following items, for Owner review and approval, within twenty-eight (28) days of notice to proceed:
1. Proposed cable routing and grouping plan.
 2. 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:
 - a. Location of sleeved wall and floor pass-thru
 - b. Size of sleeve at each location installed
 - c. Quantity of cable passing through each sleeve
 - d. Location of devices and head end equipment.
 - e. Conduit routing, size, and quantity
 3. Drawing Compliance: A letter shall be provided stating that the 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 approved by the Owner.
 4. All subcontractors shall provide submittals to general contractor for normal distribution to Architects, Engineers and the Owner's project managers.
- C. At Substantial Completion: Provide drawings, to the Owner, to reflect installed cabling with correct labeling and cable routing.
- D. Close-out Procedures: Two (2) copies of the following documents shall be delivered to the building owner's representative at the time of system acceptance. Close out technology documents shall be separated from all other trade's documents. The close out finals shall include:
1. 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.
 2. Include the Name, address and telephone of the authorized factory representative with a 24-hour emergency service number.
 3. The manual shall also include Manufacturer's data sheets and installation manuals/instructions for all equipment installed a list of recommended spare parts.
 4. Generic or typical owner's instruction and operation manual shall not be acceptable to fulfill this requirement.
 5. 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.
 6. As-built Drawings shall include cable pathways, camera locations with correct labeling and MDF/IDF locations. A copy of the As-Built drawings reflecting the final locations of all cabling shall be given to the designated Owner's representative. The as-built drawings shall be prepared using AutoCAD 2012 or later. Provide the Owner with electronic versions of the as-builts on CD media.
 7. All drawings must reflect final graphic numbering, 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.
8. A copy of the manufacturer's warranty on the installed system.
 9. Any keys to cabinets and/or equipment and special maintenance tools required to repair, maintain, or service the system.
 10. 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)
 11. 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.

1.6 QUALITY ASSURANCE

A. Contractor Qualifications:

1. The system installer shall be the authorized representative of the manufacturer to sell, install, and service the proposed manufacturer's equipment. The system installer shall have represented the security alarm manufacturer's product for a minimum of five (5) years' with experience installing and servicing systems of similar scope and complexity and evidence that is completed at least three (3) projects of similar design and is currently engaged in the installation and maintenance of systems herein described.
2. The system installer shall be licensed as required, by the State in which the project is located in, as a security services contractor to design, sell, install, and service security alarm systems.
3. The system installer shall provide 24-hour, 365 days per year emergency service with factory trained service technicians.
4. The installing firm shall have personnel on their staff that has been actively engaged in the business of designing, selling, installing, and servicing security systems for at least ten (10) years.
5. The proposing contractor for this system and the installing contractor of this system shall be of the same organization. Absolutely no subcontracting of any portion of this system by the proposing contractor will be allowed.
6. The proposing/installing contractor of this system must be an authorized dealer / integrator for the project's specified Access Control, Audio / Video Intercom, and the Intrusion Detection systems as well as the system specified in this section.
7. Contractor must be a current integrator of solution in the closest major metropolitan area marketplace, have a permanent office located within 75-miles of the project, and be able to include information on current support staff to be able to service this client.
8. 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.
9. The system installer shall submit credentials of completed manufacturer certification, verified by a third-party organization, as proof of the knowledge.
10. The Contractor shall provide four (4) current references from clients with systems of similar scope and complexity that became operational in the past three (3) years. At least three (3) of the references shall be utilizing the same system components, in a similar configuration as the proposed system
11. Contractor must be in good standing with the Owner and have no outstanding performance or warranty items at the time of bid. Any outstanding items or issues

is grounds to disqualify the Contractor for performing any work on the project.

1.7 PRE-INSTALLATION MEETINGS

- A. No less than a minimum of two weeks prior to rough-in or installation of any system devices, the Installer will be required to attend a pre-construction meeting with the Owner, Architect, and Security Consultant.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store products in manufacturer's unopened packaging bearing the brand name and manufacturer's identification until ready for installation.
- B. Handling: Handle materials to avoid damage.

1.9 PROJECT 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 recommended limits.

1.10 SEQUENCING

- A. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

1.11 WARRANTY

- A. The VSS furnished by the System Integrator including wiring, software, hardware and third-party products shall be fully warranted for parts, materials and labor for a minimum of 1 year from date of the final acceptance.
- B. Manufacturer shall provide a limited 3-year warranty for the product to be free of defects in material and workmanship.

PART 2 -PRODUCTS

2.1 GENERAL

- A. The data cabling to each camera location on this project shall be provided and installed by the data cabling contractor. The security camera installing contractor shall be responsible for the installation of all power wiring for exterior PTZ domes and power supplies.
- B. The Contractor is responsible for providing all incidental and/or miscellaneous hardware not explicitly specified below as required for a complete and operational system.
- C. Materials shall be as listed no alternate products will be allowed without prior consent of the projects security consultant. Any items approved as equivalent products shall be published by addendum ten days prior to proposal for Architect/Engineer review.
- D. All equipment and materials used shall be standard components, regularly manufactured, regularly utilized in the manufacturer's system.

- E. All systems and components shall have been thoroughly tested and proven in actual use.
- F. All systems and components shall be provided with the availability of a toll free 24-hour technical support phone number from the manufacturer. The phone number shall allow for immediate technical assistance for either the dealer/installer or the end user at no charge.
- G. All systems and components shall be provided with an explicit manufacturer warranty.
- H. Contractor to provide and install below products in accordance with project scope.

2.2 DATA CLOSET (MDF/IDF) TERMINATION HARDWARE

- A. Provide and Install new Tripplite, #B030-008-17-IP, NetDirector 8-Port 1U Rack-Mount Console HDMI KVM Switch with 17 in. LCD and IP Remote Access, Dual Rail.
- B. Security contractor is responsible to coordinate with district police technology department on acquiring network connections as well as any network configuration information such as IP numbers that will be required to connect NVR servers to district network.
- C. Security contractor is responsible to provide network cabling connection, either fiber or category 6A, to owner provided network equipment. This connection allows NVR to be connected to owner's local area network.
- D. Security contractor shall provide (1) Minuteman – E2000RTXL2U ups per NVR unit at each rack location to support NVR equipment. Provide 120v. electrical connection at location where NVR is installed.

2.3 CABLE AND INSTALLATION

- A. The Contractor shall provide and install all low voltage plenum rated power cable to exterior PTZ dome camera locations from a central power supply(s). Each power cable shall be individually fused at the power supply so a short in one power cable will blow that fuse and not affect the other cameras. The power supply will be UL listed in an approved enclosure. It is the responsibility of the Contractor to size the power supply to handle the full load of the cameras.
- B. The data cabling to each camera location on this project will be provided and installed by cabling contractor certified by Systimax and authorized to install the cable plant and connectivity products. All category 6A cable shall be Systimax Purple 2071 CAT6A.
- C. Camera contractor is responsible to request and oversee all penetrations and all conduit runs as necessary for installation of CCTV installation.
- D. All exterior penetrations require necessary weatherproofing to avoid moisture penetration.
- E. All Cameras will require 10ft purple Cat6A patch chord at camera location and 7ft purple Cat6A patch chord at panel location provided by certified Systimax Data contractor.
- F. All outdoor cable runs underground shall be in fiber rated for underground use according to Technology specs.

- G. All power circuits required for the NVR servers are to originate as emergency power from its provided UPS.
- H. Contractor shall not run any power cabling for any security equipment on rack tray system due to EMI considerations. Contractor shall provide individual cabling support for all low voltage power cabling.
- I. All cabling for entire project shall be installed at 5'-0" intervals in dedicated support system using a j-hooks support system. Cable supports will be securely attached directly to building structure. Do not attach cabling or supports to ductwork, piping, grid hangers, conduit, or equipment.
- J. Refer to CFISD structured cabling specifications for Category 6A materials and methods.
- K. All category 6A cabling shall be routed to existing MDF and IDF locations and be terminated on existing racks. Provide additional patch panels as required and label ports using existing labeling scheme.
- L. For all cameras that will exceed the maximum category 6A cable limitation the contractor shall provide and install Veracity Outreach Max universal Ethernet and Poe Extender and clearly identify on as-builts. If installed a spare unit will be provided to the owner.

2.4 PROPOSALS

- A. All proposals shall be in the format as shown in the General Conditions Section of the Specification.

2.5 DIGITAL VIDEO RECORDING, MANAGEMENT AND TRANSMISSION SYSTEM

- A. The contractor shall provide and install Network Video Recorders for this project.
- B. Final connection for all new IP cameras shall be provided by the camera contractor. Coordinate all recording settings and functions with owner prior to programming.
- C. Network Video Recorders shall be preprogrammed to include a floor plan graphic of each school and the exact camera locations and name of cameras. Field verification of camera names is required to complete this task.

2.6 EQUIPMENT REQUIRED

- A. Provide a 5 year warranty for all NVR equipment.
- B. Digital Video Recorders:
 - 1. Provide One Seneca Assurance, CT-CFISD-HDMI-RL server per 50 cameras to be installed unless stated otherwise by the owner.
 - 2. The contractor shall coordinate correct Exacq software version prior to submitting or procuring equipment.
 - 3. NVR must have SSA agreement in place for two years at time of install.
 - 4. In response to proposal, contractor shall provide owner with amounts for annual service maintenance agreement that can be purchased after warranty period has expired.

2.7 CAMERAS

- A. Camera Types:
 - 1. All ceiling mounted cameras shall be surface mounted on the ceiling using ceiling mounting kit and accessible by 10ft ladder.
 - 2. All cameras shown on the drawings to be corner mounted shall receive corner mount kit by specified camera manufacturer, no exception.
 - 3. Interior Fixed cameras shall be Bosch Flexidome 5000i or AXIS P3265LV if primary is not available. – TYPE C
 - 4. Exterior Fixed cameras shall be Bosch Flexidome 5000i or Axis P3265-LVE if primary is not available. – TYPE B
 - 5. Interior Fish Eye cameras shall be Bosch Flexidome 5100i 6mp. – TYPE E
 - 6. Multi sensor Interior/Exterior Camera shall be Axis P3727-PLE or Wisenet PNM-C16083RVQ– TYPE A
 - 7. Duo Cameras shall be AXIS P4707-PLVE Platform with IR or Wisenet PNM-7082RVD if Axis is unavailable. – TYPE D
 - 8. Axis F9114 and Axis F4105-LRE sensors shall be provided to view around a column or skylight where a center mounted single camera cannot be employed. All F4105-LRE lens must be installed with Axis TU6005 plenum cable accessory. – TYPE F
 - 9. Specialty PTZ camera will be Axis Q6318-LE PTZ if specifically called for by owner-TYPE G
- B. Field of View Determination by the contractor as necessary for fixed camera locations shall be performed at no additional cost to provide the view desired by the owner. Contractor shall coordinate all final camera views and locations with owner for final approval.
- C. IP camera address scheme will be provided to contractor by the owner. All Camera addresses shall follow the provided scheme and be sequential.
- D. Refer to Drawings for additional camera part numbers, Quantities.
- E. Confirmation of camera type per location requires customer verification.

2.8 ADDITIONAL HARDWARE OR EQUIPMENT REQUIRED

- A. Licensing to be provided for all necessary equipment.
- B. Camera mounts and brackets shall be per camera manufacturer.
- C. One ViewSonic VX3211-2K-MHD 32" LED Monitor is required per NVR.
- D. One of each type of camera used on the project is required upon final inspection for spare replacement equipment.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Fire Wall Penetrations: The Contractor shall avoid penetration of fire rated walls and floors wherever possible. Contractor shall also seal all floor, ceiling and wall penetrations in fire or smoke barriers and in the wiring closet.
- B. Provide three sided pre-finished metal hood and seal to wall where conduit penetrates

exterior wall.

- C. Install new conduit on portable pipe supports- (low profile type), as manufactured by Portable Pipe Hangers or Advanced Support Products. Provide roof protection pads under each support. Coordinate location and routing with design engineer prior to rough-in or installation of system.
- D. Do not install wall mounted cameras into metal fascia. Ensure they are mounted into brick, and sealed top sides (Not bottom)
- E. Wall Penetrations:
 - 1. Exterior Penetrations- shall be performed by a certified electrical contractor and be sleeved with metallic conduit and resealed with an Underwriter Laboratories (UL) approved sealant.
 - 2. Interior Penetrations- shall be sleeved with metallic conduit and resealed with an Underwriter Laboratories (UL) approved sealant.
- F. Cable Pathway:
 - 1. In suspended ceiling and raised floor areas where duct, cable trays or conduit are not available, the Contractor shall bundle, in bundles of 25 cables or less, with cable ties snug, but not deforming the cable geometry. Cable bundles shall be supported via "J" hooks attached to the existing building structure and framework at a maximum of five (5) foot intervals. Plenum rated cable ties shall be used in all appropriate areas. The Contractor shall adhere to the manufacturer's requirements for bending radius and pulling tension of all cables.
 - 2. Cables shall not be attached to lift out ceiling grid supports or laid directly on the ceiling grid.
 - 3. Cables shall not be attached to or supported by fire sprinkler heads or delivery systems or any environmental sensor located in the ceiling air space.

3.2 EQUIPMENT RACK CONFIGURATION

- A. 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 areas 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.
- B. All incoming cables shall be routed on the cable tray and neatly dressed down to the patch panels
- C. Cable shall be routed as closely 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.

3.3 WIRING INSTALLATION

- A. General:
 - 1. Cabling between wiring closet and camera locations shall be made as individual home runs. No intermediate splices may be installed or utilized between the wiring closet and the camera location.

2. All cable must be handled with care during installation so as not to change performance specifications.
- B. Exposed Cable: All cabling shall be installed inside walls or ceiling spaces whenever possible. Exposed cable shall only be run where indicated on the Drawings. Additional exposed cable runs shall require Owner approval, and shall only be allowed when no other options exist. Cabling shall be installed concealed at all times, except in unfinished mechanical rooms or wiring closets where cable shall be installed exposed and located to avoid conflicts with pass-through cabling, etc. Tie wraps shall be used to provide a neat appearance. Provide "D" rings or the appropriate cable guides to dress the cable.
- 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: All cabling placed in ceiling areas must be in conduit, cable tray, or J-Hooks. Cable supports 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. Attaching cable to pipes or other mechanical items is not permitted. Use J-Hooks for up to 15 cables (Caddy CAT 21 or CAT 32 hooks with appropriate brackets). All runs of sixteen (16) or more cables, provide cable rings on 36" maximum centers to hang cable. Cable shall be routed so as to provide a minimum of 18" 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 banded together every 6 feet.

3.4 DOCUMENTATION

- A. Labels: The Contractor shall label all outlets using permanent machine engraved labels approved by the Owner. Label patch panels in the wiring closet to match those on corresponding camera locations. The font shall be at least one-eighth inch (1/8") in height, block. All labels shall correspond to as-builts and to final test reports.
- B. Contractor shall ensure complete typed labeling of all cameras with numbers that correspond to locations on video server. Labeling system shall correspond to the Owner's labeling system. Verify with Owner. Provide tags (black letters on white labels, plastic coated) on all cables and outlets.
- C. All cables shall be labeled at both ends with a machine label and all terminations shall be stenciled with a typed label for quick circuit identification. Labeling shall conform to TIA/EIA standard 606 and include interconnect cable identification numbers.
- D. A floor plan, clearly labeled with all numbered camera locations, shall be included in the as-built plans.

3.5 CABLE TESTING - BY MANUFACTURER'S REQUIREMENTS

- A. Notification: The Owner/Architect/Engineer shall be notified one week prior to any testing so that the testing may be witnessed.
- B. Final Acceptance: Before requesting a final acceptance, 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 time table 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 shall be evaluated in the context of each of these factors.
- D. Errors: When errors are found, the source of each error shall be determined, corrected and the cable retested. All defective components shall be replaced and retested. Retest results must be entered on the test results form. All corrections shall be made prior to final acceptance test.

3.6 INSPECTION

- A. Conformance to the installation practices covered above are to be verified when completed. In some cases, the Owner / Architect / Engineer may observe before acceptance.

3.7 WARRANTY

- A. Labor and all other costs as necessary to maintain the equipment in operating condition as intended by the product manufacturer after a period of 1 year shall be negotiated with the owner upon project completion.
- B. Guarantee and warrant all equipment provided for a period of 3 years following date of substantial completion, or a period equal to the stated guaranty/warranty offered by the product manufacturer, whichever is the longest in duration. All such warranties shall include all parts (NVR's, and Cameras).

END OF SECTION

SECTION 28 31 00 - INTRUSION DETECTION SYSTEM (IDS)

PART 1 - GENERAL

1.1 RELATED WORK

- A. The following sections shall associate with this specification as applicable.
 - 1. General Conditions
 - 2. Supplementary Conditions
 - 3. Division 1
 - 4. Division 26 in its entirety.
 - 5. Division 27 in its entirety.
 - 6. Division 28 in its entirety.

1.2 WORK INCLUDED

- A. The Contractor shall furnish and install a complete microprocessor based Intrusion Detection System (IDS) as specified herein. The IDS shall include, but not be limited to, all control equipment, power supplies, power circuits, signal initiating and signaling devices, conduit, wire, fittings, and all other accessories required to provide a complete and operable system.
- B. IDS 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. The IDS shall include intrusion detection coverage as shown on the system floor plans. Whether shown on the floor plans or not, complete coverage of the following areas shall be included:
 - 1. All access points into the building(s), including but not limited to:
 - a. Doors
 - b. roof hatches
 - c. windows
 - 2. Interior space motion detection at the following locations:
 - a. All level 1 spaces with window and/or doors
 - b. All entrances on any level
- D. The IDS shall be the product of a single manufacturer and consist of, but not be limited to the following:
 - 1. Control Panels
 - 2. Field Devices
 - 3. Enclosures
 - 4. Locks and Keys
 - 6. Power Supplies
 - 7. Accessories required to provide a complete IDS
 - 8. System O and I Manuals
 - 9. System Programming
 - 10. Batteries
 - 11. Wiring
- E. The IDS installer shall be responsible for, but not limited to:
 - 1. Tagging of all conductors and cables at each end.

2. Provision and installation of IDS control panels.
 3. Provision and installation of IDS devices.
 4. Full coverage of all windows, doors, roof hatches.
 6. Preconstruction meeting with Owner's personnel, installing technician and project superintendent.
- F. The contractor shall connect this location to the Owner's monitoring station as designated by the owner.
- G. The Contractor shall be responsible for identifying requirements for permits, from the local the Local Authority Having Jurisdiction (AHJ), for the installation of the alarm system specified herein and shall assist the Owner in obtaining the relevant alarm permits.
- H. All conduits and back boxes shall be provided and installed by the project's electrical contractor. In the event that there is no electrical contractor on the project, responsibility will be that of the IDS installer.
- I. The documents issued for this project are conceptual in nature, including but not limited to specifications and drawings. It shall be the responsibility of the approved installer to furnish a complete and functional system, including the items shown on the drawings, in the specifications, and items not designated in either. The installer's shop drawings and product data submittals shall represent a complete system, and documents accepted do not relieve the installer from being required to provide any materials, equipment, or labor to furnish a complete and functional system as recognized by the Project's Technology Consultant and the Owner.
- J. Contractor shall integrate all Emergency Eyewash systems into the IDS. Provide cabling connecting both systems. Coordinate with Emergency Eyewash systems contractor.
- K. Contractor shall connect the Intrusion Detection System to the electrical automatic transfer switch in order to notify the District Police Department when the building is on emergency power. Provide same, connected to existing transfer switch at the existing Commons building, servicing the existing High School buildings. Provide all required cabling and devices for fully functional systems.
- L. Project scope is an expansion of the existing system.

1.3 CODES AND STANDARDS

- A. The system shall comply with the applicable Codes and Standards as follows:
1. National Electric Code, Article 760.
 2. National Fire Alarm Code (NFPA 72).
 3. Life Safety Code (NFPA 101)
- B. Administrative Council for Terminal Attachments (ACTA):
1. ANSI/TIA-968-A-2002 Technical Requirements for Connection of Terminal Equipment to the Telephone Network.
- C. American National Standards Institute (ANSI):
1. ANSI C63.4 Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.

- D. California State Fire Marshal (CSFM):
 - 1. Title 19, California Code of Regulations, Building Material Listing Program (BML).
- E. Federal Communications Commission (FCC):
 - 1. Title 47 C.F.R. Part 15; Class B – Radiated and Conducted Emissions.
 - 2. Title 47 C.F.R. Part 68; rules governing the connection of Terminal Equipment (TE) to the Public Switched Telephone Network (PSTN).
- F. The National Institute of Standards and Technology of the United States of America (NIST):
 - 1. Federal Information Processing Standards Publications 197 (FIPS 197) – Advanced Encryption Standard (AES).
- G. International Organization for Standardization (ISO):
 - 1. 9001 - Quality System.
- H. Underwriters Laboratories, Inc. (UL):
 - 1. UL 50 - Enclosures for Electrical Equipment.
 - 2. UL 294 – Access Control System Units.
 - 3. UL 365 - Police Station Connected Burglar Alarm Units and Systems.
 - 4. UL 609 - Local Burglar Alarm Units and Systems.
 - 5. UL 864 - Control Units System for Fire-Protective Signaling System.
 - 6. UL 985 - Household Fire Warning System Units.
 - 7. UL 1023 - Household Burglar Alarm System Units.
 - 8. UL 1076 – Proprietary Burglar Alarm Units and Systems
 - 9. UL 1610 - Central Station Burglar-Alarm Units.
 - 10. UL 60950-1 - Information Technology Equipment - Safety.
 - 11. UL 636 – Hold up alarms
- I. Local & State Building Codes
- J. Requirements of Local Authorities having Jurisdiction
- K. Requirements of American Disabilities Act (Public law 101-336).
- L. Texas Accessibility Standards (TAS)
- M. State Fire Marshall.
- N. State Insurance Code.

1.4 QUALITY ASSURANCE

- A. Contractor Qualifications:
 - 1. The installing contractor shall be the authorized representative of the IDS authorized/certified to sell, install, and service the proposed manufacturer's equipment. The installing contractor shall have represented the IDS manufacturer's product for at least five (5) years.
 - 2. The installing contractor shall be certified to install and setup the IDS software with Security Engine and Access Engine Modules attached.
 - 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. The System Installer must submit to the owner prior to starting any work the factory training certificates for all personnel that will be working on the specified IDS. No person is allowed to work on the IDS without proper manufacturer's certification.

1.5 SUBMITTALS AND CLOSE-OUT

- A. Product Data: Within fourteen (14) days of Notice to Proceed, the 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 system equipment, power supplies, cable, termination components, cable supports, cable labels, field 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 submitted.
 3. Construction Schedule: A time-scaled Construction Schedule indicating general project deadlines and specific dates relating to the installation of the cable distribution system.
 4. Specification Compliance: A letter shall be provided stating, by section and subsection, that the 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.
 5. Certifications: The System Installer 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.
 - a. Manufacturer's Authorized Dealer/Installer Certification: This certification must be held by the proposing/installing contractor and state that the proposing/installing contractor is and authorized dealer/installer of the system specified within the project specifications. The certification must have been obtained by the office that is within a 75-mile radius of the project's location.
 - b. 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.
 - c. Licenses: This includes all licenses required by the state in which the work is being performed, the federal government, local authorities having jurisdiction, and any organization in that governs the specific system
- B. Shop Drawings: Submit the following items, for Owner review and approval, within

twenty-eight (28) days of notice to proceed:

1. Proposed circuit routing and circuit grouping plan prepared by a system registered designer. The designer's certification must be current. Identifiable, separate routing shall be shown for both the station cabling and any backbone trunk cabling.
 2. 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:
 - a. Location of all control equipment and remote power sources
 - b. Locations of all field devices and outlets
 - c. Location of wall penetrations (all penetrations shall be sleeved and contain protective bushings at both ends)
 - d. Location of sleeved wall and/or floor pass-thru
 - e. Size of sleeve at each location installed
 - f. Quantity of cable passing through each sleeve
 - g. Conduit routing, size, quantity, and stub-up locations for any floor mounted outlets or outlets installed in casework.
 3. Drawing Compliance: A letter shall be provided stating that the 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 approved by the project's technology consultant.
- C. Close-out Procedures: For review and acceptance, furnish an electronic copy of the following documents to the Architect / Engineer. Upon acceptance of the submitted close-out documents, provide four (4) copies on an electronic storage media (CD or USD Flash Drive) Labeled with the project name, date of submission, and the name of the submitting firm. Final copies shall be delivered directly to the project's Technology Consultant. The closeout submittals shall include the following and be packaged in a storable container with the physical storage media and any physical items listed:
1. Inspection and Test Reports: During the course of the Project, the System Installer shall maintain an adequate inspection system to ensure that the materials supplied, and the work performed, conform to contract requirements. The System Installer shall provide written documentation that indicates that materials acceptance testing was conducted as specified. The System Installer shall also provide documentation, which indicates that all cable termination testing was completed and that all irregularities were corrected prior to job completion.
 2. Provide complete test reports for all cabling and devices that comprise system as outlined in this document.
 3. Include the Name, address and telephone of the authorized factory representative with a 24-hour emergency service number.
 4. The manual shall also include Manufacturer's data sheets and installation manuals/instructions for all equipment installed and a list of recommended spare parts.
 5. Generic or typical owner's instruction and operation manual shall not be acceptable to fulfill this requirement.
 6. 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 system from the original approved shop drawings.
 7. As-built Drawings shall include cable pathways; device locations with correct labeling, control equipment locations, remote power supply locations, cross

- connect locations, and lightning protection locations. The as-built drawings shall be prepared using AutoCAD 2014 or later.
8. 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.
 9. A copy of the manufacturer's warranty on the installed system.
 10. Any keys to cabinets and/or equipment and special maintenance tools required to repair, maintain, or service the system.
 11. 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)
 12. 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. Provide a video copy of the training session as well as all sign in and training sign off sheets
 13. One (1) 30" x 42" laminated floor plan sheets illustrating device locations, system wiring configuration, and cable designation. The System Installer shall provide one complete floor plan sheet at each panel location

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS AND INSTALLERS

- A. Acceptable Manufacturer: Bosch Security Systems, Inc.; 130 Perinton Parkway; Fairport, NY 14450. ASD. Toll Free Tel: 800-289-0096. Tel: 585-223-4060. Email: request info (presales.support@us.bosch.com). Web: www.boschsecurity.us.
- B. Substitutions: Not permitted.
- C. Requests for substitutions will be considered in accordance with provisions of Division 1

2.2 CONTROL COMMUNICATOR (Panel)

- A. The IDS control panel shall be Bosch Security Systems, Inc., model # B9512G comprising a fully integrated intrusion, fire, and access control system. The control panel shall support the following:
 1. The IDS system is 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 1 system instead of 3
 2. Telephone Line Module 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 at minimum 500 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.
 13. Supervision of peripheral devices and communications interface(s).
- B. All small installations such as press boxes or tractor sheds shall use Bosch Model #5512 main control panel.
- C. Programmable features shall include:
1. Independently control zones through an independent zone control keypad.
 2. Automatic test reports.
 3. Selective zone shunting.
 4. Custom text on the associated command centers.
- D. Zone Expansion - Expanded to 500 (8 on-board, 492 off-board) 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 B915 Command Center and they can be reported to a Radionics D6600Receiver.
- E. User Pass Codes – nine hundred ninety-nine (999) user pass codes shall be available to identify the user when arming/disarming the system.
- F. 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 500 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 end-of-line resistor supervisor.
 3. Minimum total points, 500.
- G. Entry/exit delays shall be independently programmable from 10 to 150 seconds. A pre-warn audible shall be coincident with the entry delay.
- H. 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.
- I. Remote control via the use of the dial-up telephone and owner's 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.
- J. 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.
- K. 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.
- L. Command centers shall be microprocessor-based
1. 16 character illuminated alpha-numeric display.
 2. Burglary and fire sounders.
 3. Backlight 15-key touchpad.
 4. Pre-warn tone.
 5. The arming station shall have the ability to annunciate the English language format via the 16 character alphanumeric display by the following:
 - a. Master zone (alarm, service, faulted, and function), POPIT (alarm, service, faulted, missing, extra, function, and location), arm/disarm status (system diagnostics, time/day/date, and user prompts).
 6. Additional features shall include local system test, sensor reset, panic and/or medical and/or duress alarm initiation, independent master zone by-pass with automatic restoration to normal status to next system arming, perimeter watch mode, user changeable pass codes, remote programming initiation, and system/monitoring service test.
 7. Radionics model B915, and shall be functional at each of the locations shown on the floor plans.
 8. Non-school oriented buildings will use Radionics Model B942 Touch Screen Keypads
- M. Modules and Accessories
1. POPEX Module (Zone Expansion B299)
 2. B8103 Main Panel Enclosure & D101 Lock set- one required for the main panel and one for each quadrant of the project receiving a B299.
 3. D9002-5 6 location 3 hole Mounting plate- adapter used for hanging modules

- in all expansion panels.
4. B430 Telephone Line Interface
 5. B308 Octo-Relay module - provides eight form "C" dry contact relay outputs for a variety of programmable responses to alarm, trouble and other system conditions.
 6. Auxiliary power supplies as required for powering of motion detectors, Altronix Power Supply (Part # SMP10PM12P8) - one required for each quadrant of the project receiving a B299.

2.2 FIELD DEVICES

- A. Ceiling mounted 360 Degree, infrared sensors / microwave motion sensors. Model DS 9370
 1. Bracket for direct mounting to standard 3-1/2" and 4" electrical back boxes.
 2. All units must be adjusted/masked to reduce false signals for the covered area.
 3. Contractor to provide a dedicated POPIT for each motion detector on the project.
- B. Ceiling mounted 200ft Long Range infrared sensor. Model DS794Z
 1. Bracket for direct mounting to standard 3-1/2" and 4" electrical back boxes.
 2. All units must be adjusted/masked to reduce false signals for the covered area.
 3. Contractor to provide a dedicated POPIT for each motion detector on the project
- C. Wall mounted, high performance, Tri Tech PIR/Microwave sensor, Model ISC-CDL1-W15G
 1. Bracket for direct mounting to standard 3-1/2" and 4" electrical back boxes.
 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 model correct protective wire cage in gymnasiums.
 4. Contractor to provide a dedicated POPIT for each motion detector on the project.
- D. Magnetic Door / Hatch / Overhead Contacts
 1. Where exposed contacts are used they shall be heavy duty switches protected by die cast aluminum housing and the leads shall be encased in steel armor jacket. The leads must pass through the back box by the correct size twin screw cable clamp connector.
 2. Magnetic Door / Hatch contacts shall be model Sentrol 2505A-L contact
 3. Overhead Roll up contacts shall be model Ademco 958 contact
 4. Contractor to provide a dedicated POPIT for each entry door, set of doors, roof hatch or rollup door on the project.
- E. Glass Break Detector
 1. Bracket for direct mounting to standard 3-1/2" and 4" electrical back boxes.
 2. Provide model correct protective wire cage in gymnasiums.
 3. Glass breaks shall be Model GE 5812-RND or Bosch DS-1108DI
 4. Contractor to Provide dedicated POPIT for each room of glass break detectors on the project.
- F. Sirens

1. Shall be installed on Wall / Ceiling within 50 foot of every keypad location.
2. Wired directly to corresponding relay module and not the main control panel.
3. Sirens shall be Model SSX-52 Amseco.

2.3 WIRING

- A. All wiring shall be by the manufactures (Bosch/Radionics) specifications. All cable is preferred but not limited to be shielded.
- B. Each area of a building shall provide its own Popex Module(s), Power supply(ies) and enclosure(s) in that areas IDF. All areas considered should be at minimum 500ft from the main panel or as otherwise instructed by owner.
- C. All 120v Power shall be furnished by the contractor.
- D. All Security system conduits as show on the drawings shall be furnished by the contractor as part of their scope of work.
- E. Coordination with the electrical contractor is the responsibility of the Security Contractor to ensure all conduit is in place for a complete installation.
- F. All systems shall be connected to an emergency power source as available.
- G. Color code of all security intrusion detection system and access control wiring shall be purple in color.
- H. Approved Products:
 1. 18/2 unshielded:
Belden #6300UE0071000
Tappan Wire & Cable, Inc. #P40020.122
 2. 18/4 unshielded:
Belden #6302UE0071000
Tappan Wire & Cable, Inc. #P41387.28
 3. 18/6 unshielded:
Belden #6304UE0071000
Tappan Wire & Cable, Inc.

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 maybe 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 Article760 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" not to 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 such as inside 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. Provide a Green Systimax Category 6 telephone cable from the Master Control Panel to the Telephone Equipment room.
- I. (2) 18-4 wires will be run from the panel to the prior designated future portable connection location and labeled in plain English on both ends. These spares are to be left above the ceiling with 10ft of slack at minimum.
- J. Each set of glass breaks 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 entries are to be connected into separate POPIT modules for separate identification.
- L. Provide and install (1) dedicated POPIT for each 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 to be mounted on the wall nearest to the device the POPIT Module is associated with. All boxes shall be labeled with the appropriate corresponding point contained within.
- 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 POPIT modules on project shall be mounted above drop ceiling in an area easily accessible by an 8 or 6 ft ladder.
- P. All keypads, sirens and POPEX modules shall have dedicated homeruns from each device to the master control panel. Do not daisy chain keypads or sirens. Chaining of modules is permitted if location serves multiple areas of coverage.
- Q. All POPIT modules and power supplies are required to be located on as-built drawings delivered to owner at or before substantial completion of project.
- R. Contractor shall install communication wire from provided exterior connection at freezer/cooler control panels to burglar alarm via POPIT module interface to notify panel should freezer/cooler encounter high temperature condition. Coordinate

programming and testing of module with owner.

- S. All POPEX modules and power supplies shall be installed in IDF closets for that area of coverage with easy accessibility and a dedicated SDI2 homerun to the master control panel not to exceed 500ft.
- T. All device power runs shall be fused and clearly labeled in plain English at each main power source.
- U. All Eyewash stations shall have a dedicated POPIT module interface per device on the project and be wired Normally closed for monitoring purposes.
- V. Any generator on site must be monitored through a dry Normally closed contact connection to a dedicated POPIT module and tested to confirm its function for main building AC Loss.

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 Manufacturer:
Panduit Corporation
Erico/Caddy
B-Line
Supports shall be sized appropriately for the number of wires being supported. 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 cable support hook to the treaded rod.
- 3. The cable support shall be installed at a maximum of 5' on center.
- 4. All cable installed shall be attached to the cable 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 control 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 shall be coordinated with the owner prior to final programming:

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.
- B. Any Extended Manufacturer's Warranty will be provided to the Owner if the Sub-contractor entitled to the job has an agreement for an extended warranty already in place with the Manufacturer.

3.7 SOFTWARE

- A. Provide two electronic copies of the final programming and program software to the

Owner's Police Technology Foreman after final approval.

END OF SECTION

SECTION 28 46 00 - FIRE DETECTION AND ALARM SYSTEM

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Provide all detailed engineering, documentation, materials and devices, installation, calibration, software programming and check-out necessary for a complete and fully operational fire detection and alarm system in accordance with the full intent and meaning of the drawings and specifications including, but not limited to, the following:
 - 1. Supply, install and connect all hardware necessary to provide a complete and operational fire detection and alarm system.
 - 2. Supply, install and wire all field hardware, fire alarm control panel, power supplies, power circuits, alarm initiating devices, audible and visual alarm devices, auxiliary control relays, signal initiating and signaling devices, conduits, wires, fittings and all accessories required for the system to perform as specified as required.
 - 3. Supply, install, debug and test all software required to provide all software functions described in accordance with the full intent and meaning of the drawings and specifications.
 - 4. Coordinate the work specified under this Section with other trades and contractors to assure a complete and fully operational system.
- B. The intent of fire detection and alarm system work is specified in this section and indicated on the drawings. The installing contractor shall design and provide a complete system, meeting the requirement of this specification. The Contractor shall provide all fire alarm and initiation devices required for a complete system acceptable to all governing authorities. Provide proper spacing and coverage of all devices.
- C. Expand existing fire alarm / voice evacuation system for remodel and addition.

1.2 RELATED SECTIONS

- A. Division 22 and Division 23
- B. Sprinkler Systems
- C. Elevators
- D. Food Service

1.3 CODES / STANDARDS / REFERENCES (LATEST EDITIONS)

- A. National Fire Protection Association (NFPA):
 - 1. NFPA1 Fire Code
 - 2. NFPA 13 Systems, Installation
 - 3. NFPA 17 Dry Chemical Extinguishing Systems
 - 4. NFPA 70 National Electrical Code
 - 5. NFPA 72 National Fire Alarm and Signaling Code.
 - 6. NFPA 80 Fire Doors and Fire Windows
 - 7. NFPA 90A Standard for the Installation of Air Conditioning and Ventilating Systems.
 - 8. NFPA 92A Smoke Control Systems
 - 9. NFPA 101 Life Safety code.
 - 10. NFPA 105 Smoke Control Door Assemblies
 - 11. NFPA 1221 Standard for the Installation, Maintenance and Use of

FIRE DETECTION AND ALARM SYSTEM

284600-1

Salas O'Brien Registration #F-4111

- 12. NFPA 2001 Emergency Services Communications Systems.
Fire Extinguishing Systems, Clean Agent
- B. UL: Underwriters Laboratories, Inc.
 - 1. 217 Single and Multiple Station Smoke Detectors.
 - 2. 268 Smoke Detectors for Fire Protective Signaling Services.
 - 3. 864 Control Units for Fire Protective Signaling Services, 9th Edition.
 - 4. 864 Transient protection
 - 5. 1480 Speakers for Fire Protective Signaling Systems
 - 6. UL Fire Protection Equipment Directory.
 - 7. UL Electrical Construction Materials Directory.
- C. Uniform Federal Accessibility Standards (UFAS).
- D. Factory Mutual P7825 Approval Guide
- E. American National Standards Institute (ANSI).
- F. National Electrical Manufacturer's Association (NEMA).
- G. Institute of Electrical and Electronic Engineers (IEEE).
- H. Electronic Industries Association (EIA-232-C): Interface between Data Terminal Equipment and Data Communication Equipment Employing Serial Binary Data Interchange.
- I. Requirements of American Disabilities Act (Public Law 101-336).
- J. Local Accessibility Standards
- K. State Fire Marshall or Requirements of Local Authorities having Jurisdiction
- L. State Insurance Code
- M. International Building and Fire Code Adopted by Local Authority Having Jurisdiction
- N. Local & State Building Codes
- O. In addition the above requirements, comply with all local codes. Where discrepancies exist between codes, drawings or specifications, the more stringent requirement shall prevail. Installation shall be subject to approval, inspection and test of applicable regulatory agencies.

1.4 MANUFACTURER'S, PLANNER'S AND INSTALLER'S QUALIFICATIONS

- A. The manufacturer shall regularly and presently produce, as the manufacturer's principle products, the equipment and material of the type and design specified for this project, and shall have manufactured the item for at least 5 years.
- B. Manufacturer's product shall have been in satisfactory operation on three installations of similar size, type and design as this project, for approximately 3 years.
- C. Manufacturer shall submit at the time of bid a list of installations where the products have been in operation.
- D. The installing contractor shall have been actively engaged in the business of designing,

selling, installing, and servicing fire alarm systems for at least ten (10) years.

- E. The entire Fire Detection and Alarm System shall be installed by an authorized representative of the Fire Alarm Manufacturer and certified by the manufacturer to distribute, sell, and install the specified fire alarm and smoke detection system. Include all components, elements, and testing and acceptance procedures.
- F. If the submitted system is being supplied by an authorized distributor of the equipment manufacturer, the distributor shall have been actively engaged in the sale, installation and service of the type of system proposed for this project for a minimum of 10 years.
- G. Any proposed installer who cannot show evidence of such qualifications may be rejected. The services of a technician provided and certified by the equipment manufacturer shall be provided to supervise the installation and tests of the system.
- H. Furnish evidence there is an experienced and effective service organization, which carries a stock of repair parts for the system to be furnished.
- I. The installing contractor shall be licensed by the State Fire Marshall to design, sell, install, and service fire alarm systems as required by the State Insurance Code.
- J. The installing contractor shall have on his staff a minimum of two (2) Fire Alarm Planning Superintendent (APS) 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 State Insurance Code.
- K. The APS shall be a certified NICET Level III state licensed fire alarm planner under whose supervision system design shall take place. In lieu of a NICET certified state licensed fire alarm planner, the contractor or supplier may provide design supervision by a registered professional engineer, who regularly engages in the design of fire alarm systems as required by the Texas Board of Professional Engineers.
- L. The installing contractor shall provide 24-hour, 365 days per year emergency service with factory trained, state licensed service technicians.
- M. Material shall be new and in perfect condition when installed.
- N. Electrical or electronic equipment provided under this Division which has been damaged, exposed to weather, or is, in the opinion of the Architect/Engineer otherwise unsuitable because of improper fabrication, storage, or installation, shall be removed and replaced with new equipment, at no additional cost to the owner.
- O. Quality Control Assurance:
 - 1. All components of the fire alarm system shall be products of an Underwriters Laboratories, Inc. listed fire alarm manufacturer, and shall bear the UL Label. Partial listing shall not be acceptable.
 - 2. All components of the fire alarm systems shall use the most current technology available.
 - 3. Only new parts shall be installed at the time of initial installation and to repair the system during the warranty period. No reconditioned parts shall be used.
 - 4. All devices shall be tested and certified that they meet or exceed the "Service Life Expectancy Rating" as outlined by UL and NFPA.

1.5 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.

- B. Contractor shall schedule a pre-construction meeting with Owner/Architect regarding the Fire Detection and Alarm System.

1.6 DEFINITIONS

- A. General: Wherever mentioned in this specification or on the drawings, the equipment, devices and functions shall be defined as follows:
 1. Alarm Signal: A signal, which signifies a state of emergency requiring immediate action and immediate notification of the Fire Department. These are signals such as:
 - a. The operation of a manual station.
 - b. The operation of a fire suppression system switch.
 2. Pre-Alarm Signal: A signal, which indicates a detection device, has operated. These signals require an immediate response, but do not require immediate notification of the Fire Department.
 3. Supervisory Signal: A signal, which signifies the impairment of fire protection system, which may prevent its normal operation.
 4. Trouble Signal: A signal, which indicates that a fault, such as an open circuit or ground, has occurred in the system.
 5. Alarm Zone: An alarm initiating device or combination of devices connected to a single alarm initiating device circuit.
 6. Pre-Alarm Zone: A detector or group of detectors connected to a single detector circuit, which can send an alarm to the central control panel.
 7. Supervision Zone: A supervisory signal initiating device or combination of such devices connected to a single supervisory signal circuit.
 8. Communication Zone: A fire alarm indicating device or series of devices arranged to visually and/or audibly indicate a fire alarm signal.

1.7 SUBMITTALS

- A. Contractor shall meet with Owner's Fire Alarm System representative prior to submission of formal/final shop drawings to Architect to allow the Owner and Architect to review a preliminary draft copy of the submittal to verify compliance with the specifications and any detailed requirements of the project. After the draft submittal has been reviewed by the Architect / Owner / Engineer, and formal shop drawings have been reviewed by Architect and returned to the Contractor, the required pre-construction meeting shall take place with Owner / Architect / Engineer.
- B. Before the final set of shop drawings are submitted to Architect / Engineer, submit drawings to the jurisdictions for approval. All approvals shall be noted on the drawings or by letter from the authorities having jurisdiction (AHJ).
- C. All preliminary and as-built design drawings and supporting documentation shall include: Floor Plan Drawings, riser diagrams, control unit wiring diagrams, point to point wiring diagrams, and typical wiring diagrams as described herein.
 1. Name of Owner and Occupant
 2. Date
 3. Location, including street address.
 4. Provide a complete written, item-by-item, line-by-line, specification review stating compliance or deviation in full description.
 5. Device Legend
 6. Input/output programming matrix
 7. Licensed Designer Information – Registered Professional Engineer or Alarm Planning Superintendent (APS)

8. Battery calculations
9. Notification appliance circuit voltage drop calculations
10. Floor Plan
 - a. Floor identification
 - b. Point of compass
 - c. Correct graphic scale
 - d. All walls and doors
 - e. All partitions extending to within 15 percent of ceiling height
 - f. Room descriptions
 - g. Fire alarm device / component locations
 - 1) Signal notification devices
 - 2) Initiation devices
 - 3) Smoke control systems
 - 4) Initiation of automatic extinguishing equipment
 - 5) Doors that unlock or close automatically
 - 6) Zone verification for detection devices
 - 7) Fire/Smoke damper control
 - 8) Fire alarm panel location
 - 9) Fire alarm annunciators
 - 10) Control valves to Fire Protection System
 - 11) Duct smoke detectors
 - 12) Supervisory devices
 - 13) Elevator location
 - 14) Elevator recall system location
 - h. Location of fire alarm primary power connections
 - i. Location of monitor/control interfaces to other systems
 - j. Riser locations
 - k. Methods for compliance with NFPA 72 24.3.13 for survivability (emergency voice systems) as required in NFPA 72 12.4 where applicable.
 - l. Ceiling height and ceiling construction details
 - m. Fire alarm system riser diagram
 - 1) General arrangement of the system, in building cross-section
 - 2) Number of risers
 - 3) Type and number of circuits in each riser
 - 4) Type and number of fire alarm components/devices on each circuit, on each floor or level
11. Control unit wiring diagrams shall be provided for all control equipment, power supplies, battery chargers, and annunciators and shall include the following:
 - a. Identification of control equipment depicted
 - b. Location(s)
 - c. All field wiring terminals and terminal identification
 - d. All indicators and manual controls, including the full text of all labels
 - e. All field connections to supervising station signaling equipment, releasing equipment, and fire safety control.
 - f. Typical Wiring Diagram shall be provided for all initiating devices, notification appliances, remote light emitting diodes (LEDs), remote test stations, and end-of-line and power supervisory devices.
12. Complete system bill of material of all hardware components.
13. Detailed system operational description. Any specification differences and deviations shall be clearly noted and marked.
14. Submittal sheets sequentially numbered with the format: sheet number of number total. For example: 1 of 3.
15. Complete set of manufacturer's operating instructions, circuit diagrams and the information necessary for proper installation, operation and maintenance.
16. Manufacturers catalog cut sheets shall be provide for each piece of equipment with the appropriate model or part number highlighted in cases where multiple model

numbers or part numbers are shown.

17. Fire detection and alarm system's panel configuration complete with peripheral devices, batteries, power supplies, and interconnection diagrams.
18. Submit sound and visual level to confirm that number and location of signaling devices will provide required sound and visual levels throughout the building.
19. Sample of proposed graphic/text annunciation.

1.8 OPERATION AND MAINTENANCE MANUALS

- A. Submit complete sets of operation and maintenance manuals. Manual, less as-builts, and sign-off sheets, shall be provided upon completion of the work. Approval of the manual will be required prior to substantial completion.
- B. The Operation and Maintenance Manual shall consist of the following:
 1. The manual shall include the names, addresses and telephone numbers of each Contractor installing products, and of the nearest service representative for each product. The manual shall have a Table of Contents and tab sheets. Update manuals to include modifications made during installation, checkout and acceptance. The manual shall include the sections described in the following paragraphs.
 2. The Functional Design Section shall identify the operational requirements for the system and explain the theory of operation, design philosophy, and specific functions. Hardware and software functions, interfaces, and requirements shall be provided for system operating modes.
 3. The Hardware Section shall describe equipment provided, including general description and specifications, installation and checkout procedure, electrical schematics and layout drawings. Alignment and calibration procedures, manufacturer's repair parts list indicating source of supply, interface definition, signal identification and wiring diagrams. Also, include a complete parts list of all components as well as a list of recommended spare parts. The spare parts list shall include, for each item, the manufacturer's name, the model of the part, and serial number, if appropriate, and a physical and electrical description of the part.
 4. The Software Section shall describe programming and testing, starting with a system overview and proceeding to a detailed description of each software module, to instruct the user on programming or reprogramming any portion of the system and other information necessary to enable proper system usage.
 5. The Operation Section shall provide instructions for operation of the system, including system start-up procedures, use of system and applications software, alarm presentation (where applicable), failure and recovery procedures, preventive maintenance schedule, parameter schedules and sequence definition, and system access requirements.
 6. The Maintenance Section shall provide descriptions of maintenance for equipment including inspection, periodic preventive maintenance, fault diagnosis, and repair or replacement of defective components.
 7. The Shop Drawings section shall include copies of all approved shop drawings and submittal materials updated to "AS BUILT".

1.9 AS-BUILT DRAWINGS

- A. Prepare and submit detailed "As-Built" drawings. The drawings shall include certified test of the system, testing and acceptance sign-off sheets, and other items specified elsewhere to be performed after initial submission of operation and maintenance manuals, complete wiring diagrams showing connections between all devices and equipment, both factory and field wired. Include a riser diagram and drawings showing the as built location of all devices and equipment. The drawings shall show the system as installed, including all deviations from both the project drawings and the approved shop

drawings. The drawings shall be prepared on uniform sized sheets, the same size as the project drawings. The plan drawings shall be 11x17 inch and inserted in the specified Operations and Maintenance Manuals. Provide electronic copies in PDF and Autocad.dwg format.

1.10 OPERATIONAL INSTRUCTIONS

- A. Provide a typeset printed or a laser jet printed instruction card mounted behind a lexan plastic or glass cover in a stainless steel or aluminum frame. Install the frame in a conspicuous location observable from the Fire Alarm Control Panel (FACP). The card shall show those steps to be taken by an operator when a signal is received as well as the functional operation of the system under all conditions, normal, alarm, and trouble. The instructions shall be approved by the Architect/Engineer before being posted.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturers acceptable contingent upon Products' compliance with the specifications:
 - 1. Notifier INSPIRE series or its successor
 - 2. Siemens-Cerberus PRO Modular
- B. Additional Instructions
 - 1. All equipment, materials, accessories, devices, etc. covered by this standard and/or noted on the contract drawings shall be new and unused and be U.L. listed for their intended use.
 - 2. All equipment provided shall be available for purchase from at least two authorized distributors within the greater Houston metropolitan area. Single source proprietary equipment is prohibited unless approved by CFISD.

2.2 SYSTEM DESCRIPTION

- A. System shall be a completely multiplexed addressable fire detection and alarm system, tested and left in first class operating condition. Voice evacuation systems where required or specified, shall have voice alarm notification wherever audible notification is required.
- B. The system shall provide communication with initiating and control devices individually. All of these devices shall be individually annunciated at the fire alarm control panel. Annunciation shall include the following conditions for each point:
 - 1. Alarm
 - 2. Trouble.
 - 3. Open
 - 4. Short
 - 5. Device missing/failed.
- C. System circuits shall be wired as follows: Notification Appliance Circuit (NAC) shall be Style B supervised and signal line circuit (SLCs) shall be Style 4 as describe in NFPA 72.
- D. The system shall contain independently supervised initiating device circuits. The alarm activation of any initiation circuit shall not prevent the subsequent alarm operation of any other initiation circuit. All addressable loops shall have loop isolation protection devices to maintain partial fire alarm system integrity should a fault occur. A loop isolation device shall not exceed a maximum of 20 devices.
- E. There shall be supervisory service initiation device circuits for connection of all sprinkler water flow switches and valves. Device activation shall cause a general alarm at the fire

- alarm control panel. Each flow and tamper switch shall have an individual address.
- F. There shall be independently supervised and independently fused indicating appliance circuits for all alarm signaling devices. Disarrangement conditions of any circuit shall not affect the operation of other circuits.
 - G. Auxiliary manual controls shall be supervised so that an "off normal" position of any switch shall cause an "off normal" system trouble.
 - H. The incoming power to the system shall be supervised so that any power failure must be audibly and visually indicated at the fire alarm control panel. A green "power on" LED shall be displayed continuously while incoming power is present at the building fire alarm control panel.
 - I. The system batteries shall be supervised so that a low battery condition or disconnection of the battery shall be audibly and visually indicated at the building fire alarm control panel.
 - J. The system modules shall be electrically supervised for module placement. Should a module become disconnected, the system trouble indicator shall illuminate and the audible trouble signal shall sound.
 - K. The system shall have provisions for disabling and enabling all circuits individually for maintenance or testing purposes.
 - L. The system shall be provided with sufficient battery capacity to operate the entire system upon loss of normal 120 VAC power in a normal or supervisory mode for a period of 24 hours with 20 minutes of alarm operation at the end of this period as a minimum. The system shall automatically transfer to the standby batteries upon power failure. All battery charging and recharging operations shall be automatic. If batteries are fully discharged, the charger shall recharge them back to full charge in four hours.
 - M. All external circuits requiring system operating power shall be 24 VDC and shall be individually fused at the respective fire alarm control panel.
 - N. All addressable devices shall have the capability of being disabled or enabled individually from the fire alarm control panel.
 - O. A maximum of 75 percent capacity of addressable devices shall be multi-dropped from a single pair of wires. Systems that require factory reprogramming to add or delete devices within the capability of the designed system are unacceptable. Expansion of the designed system shall be accomplished by factory reprogramming.
 - P. The communication format to the addressable devices shall be a completely digital poll/response protocol to allow t-tapping of the circuit wiring. A high degree of communication reliability must be obtained by using parity data bit error checking routines for address codes and check sum routines for the data transmission portion of the protocol.
 - Q. Each addressable device must be uniquely identified by an address code. The system must verify that proper type device is in place and matches the desired software configuration. All remote or external panels shall have an individual address for monitoring.
 - R. Wiring type, distances, survivability, and wiring configuration types shall be approved by the equipment manufacturer. The system shall allow a line distance of up to 2,500 feet to the furthest addressable device on a Style B circuit. Plenum rated fire alarm cable shall

have an outer jacket insulation color of red.

Minimum wire size shall be:

Initiating Circuits: 18 AWG

Strobe Circuits: 14 AWG

Relay Control Circuits: 18 AWG

Voice/Speaker Circuits: 16 AWG

- S. Each panel extender shall have an individual address.

2.3 FIRE ALARM CONTROL PANEL (FACP)

- A. The FACP shall be capable of communicating with the types of addressable devices specified below. It shall display only those primary controls and displays essential to operation during a fire alarm condition. Keyboards or keypads shall not be required to operate the system during fire alarm conditions. Panel shall support a minimum of 500 addressable points.
- B. The fire alarm control panel (FACP) shall be fully enclosed in a lockable steel enclosure as specified herein. All operations required for testing or for normal care and maintenance of the system shall be performed from the front of the enclosure. If more than a single unit is required to form a complete control panel, the unit enclosures shall match exactly. The system shall operate at 24 VDC.
- C. Panel shall be large enough to accommodate all components and also to allow ample gutter space for interconnection of all panels as well as all field wiring. Each enclosure and each component shall be identified by an engraved red laminated phenolic resin nameplate. Lettering on the nameplate shall not be less than 1" high. Individual components and modules within the cabinets shall be identified by engraved laminated phenolic resin nameplates.
- D. A local audible device shall sound during alarm, trouble, or supervisory conditions. This audible device shall sound differently during each condition to distinguish one condition from another without having to view the panel. This audible device shall also sound during each key press to provide an audible feedback to ensure that the key has been pressed properly.
- E. The following primary controls shall be visible through a front access panel:
1. Minimum 3-lines, minimum 40 alphanumeric characters per line display.
 2. Individual red system alarm LED.
 3. Individual yellow supervisory service LED.
 4. Individual yellow trouble LED.
 5. Green "power on" LED.
 6. Alarm acknowledge key.
 7. Trouble acknowledge key.
 8. Alarm silence key.
 9. System reset key.
- F. Under normal condition, the front panel shall display a "SYSTEM IS NORMAL" message and the current time and date.
- G. Should an abnormal condition be detected, the appropriate LED (Alarm, Supervisory or Trouble) shall flash. The panel audible signal shall pulse for alarm conditions and sound steady for trouble and supervisory conditions.
- H. System Display:
1. The system shall support the following display mode options:

2. The display shall include a minimum 80-character backlit alphanumeric Liquid Crystal Display (LCD) or comprehensive LCD wide format display or graphic user interface (GUI).
3. The display shall annunciate status information and custom alphanumeric labels for all intelligent detectors, addressable modules, internal panel circuits, and software zones.
4. The display shall also provide Light-Emitting Diodes.
 - a. The display shall provide minimum 8 Light-Emitting-Diodes (LEDs) that indicate the status of the following system parameters:
AC POWER
FIRE ALARM
PRE-ALARM WARNING
SECURITY ALARM
SUPERVISORY SIGNAL
SYSTEM TROUBLE
DISABLED POINTS
ALARM SILENCED
5. The display shall also provide keypad functions.
 - a. The display keypad shall be an easy to use QWERTY type keypad, similar to a lap-top PC keyboard. This shall be part of the standard system and have the capability to command all system functions, entry of any alphabetic or numeric information, and field programming. Two different password levels shall be provided to prevent unauthorized system control or programming.
- I. Alarm conditions shall be displayed on the alphanumeric display. The top line of 40 characters shall be the point label and the second line shall be the device type identifier. The system alarm LED shall flash on the control panel until the alarm has been acknowledged. Once acknowledged, this same LED shall latch on. A subsequent alarm received from another zone shall flash the system alarm LED on the control panel. The alphanumeric display shall show the new alarm information.
- J. Each independently supervised circuit shall include a discrete readout to indicate disarrangement conditions per circuit.
- K. Acknowledgment for each abnormal condition shall be provided. Acknowledge keys shall not be pass code protected. Acknowledge keys shall be protected by the locked enclosure only. After all points have been acknowledged, the LEDs shall glow steady and the audible device be silenced. The total number of alarms, supervisory and trouble conditions shall be displayed, along with a prompt to review each list chronologically. The end of the list shall be indicated by the message, "END of LIST".
- L. Pressing the appropriate acknowledge button shall display the first unacknowledged condition in the appropriate list (either alarm, supervisory or trouble), and shall require another acknowledge button for each subsequent alarm condition. Press to acknowledge shall only silence the displayed point.
- M. Alarm silencing:
 1. Should the "Alarm Silence" button be pressed, all audible alarm signals shall cease operation.
 2. Visual signals shall not be extinguished during alarm silence inhibit mode.
- N. System reset:
 1. The "System Reset" button shall be used to return the system to its normal state after an alarm condition has been remedied. The alphanumeric display or reset LED shall step the user through the reset process with simple English Language

- messages.
2. Should an alarm condition continue to exist, the system shall remain in an abnormal state. System control relays shall not reset. The audible device and the alarm LED shall be on.
 3. Should the alarm silence inhibit function be active, the System Reset and alarm silence key shall be ignored.
- O. Additional function keys, or their equivalent, shall be provided to access status data and control the function for the following points:
1. HVAC - Bypass
 2. Indicating appliance circuits bypass
 3. Auxiliary relays points bypass
 4. All other input/output points.
- P. The following status data or their equivalent shall be available:
1. Primary state of point.
 2. Device, PID and card type information.
 3. Current priority of outputs.
 4. Disable/enable status.
 5. Verification tallies of initiating devices.
 6. Automatic/manual control status of output points.
 7. Acknowledge status.
 8. Relay status.
- Q. LED supervision: Where provided, all slave module LEDs shall be supervised for burnout or disarrangement. Should a problem occur the alphanumeric display shall display the module and LED location numbers to facilitate location of that LED.
- R. System trouble reminder: should a trouble condition be present within the system and the audible trouble signal silenced, the trouble signal shall resound at pre-programmed time intervals to act as a reminder that the fire alarm system is not 100% operational. Both the time interval and the trouble reminder signal shall be programmable.
- S. The fire alarm control panel features shall include, but not be limited to:
1. Setting of time and date.
 2. LED testing.
 3. Alarm, trouble, and abnormal condition listing.
 4. Enabling and disabling of each monitor point separately.
 5. Activation and deactivation of each control point separately.
 6. Changing operator access levels.
 7. Walk test enable.
 8. Running diagnostic function.
 9. Displaying software revision level.
 10. Displaying historical logs.
 11. Displaying card status.
 12. Point listing.
 13. For maintenance purposes, the following lists, or their equivalent, shall be available from the system program and/or the point lists menu:
 - a. All points list by address.
 - b. Monitor point list.
 - c. Signal list.
 - d. Auxiliary control list.
 - e. Feedback point list.
 - f. LED/switch status list.
 14. Fire Drill:
 - a. Fire drill activation switch shall activate all audio/visual devices only. Fire

- drill shall not enter into the alarm sequence of operation, shall not close smoke or fire/smoke dampers, shall not deactivate any HVAC systems, kitchen hoods, etc.
- b. Activation of any trouble or alarm condition shall supercede the evacuation drill.
 - c. Fire drill shall be canceled by the system reset key, alarm silence, or drill key.
15. Scrolling through menu options or lists shall be accomplished in a self-directing manner. These controls shall be located behind an access door.
 16. The alphanumeric display shall have an alpha numeric, back-lighted LCD, LED, or gas plasma display. The display shall support numeric and both upper and lower case letters. Lower case letters shall be used for soft key titles and prompting the user. Upper case letters shall be used for system status information. A cursor shall be visible when entering information.
 17. The system shall be capable of being tested by one person. The actuation of the "enable walk test" program at the fire alarm control panel shall activate the "Walk Test" mode of the system, which shall cause the following to occur:
 - a. The remote monitoring circuit connection shall be bypassed.
 - b. Control relay functions shall be bypassed.
 - c. The control panels shall show a trouble condition.
 - d. The panel shall be capable of selecting either: the alarm activation of any initiation device causing the audible signals to activate for two seconds or the alarm activation of any initiation devices causing the audible signals to code a number of pulses to match the zone number.
 - e. The panel shall automatically reset itself after signaling is complete.
 - f. Any momentary opening of an initiating or indicating appliance circuit wiring shall cause the audible signals to sound for 4 seconds indicating a trouble condition.
 - g. The control panel shall be capable of supporting up to 8 separate testing groups whereby one group of points may be in a testing mode and the other (non-testing) groups may be active and operate as programmed per normal system operation. After testing is considered complete, testing data may be retrieved from the system in chronological order to ensure device/circuit activation.
 - h. Should the walk test feature be on for an inappropriate amount of time, it shall revert to the normal mode automatically.
 18. Provide three (3) access levels with level 3 being the highest level. Level 1 action shall not require a pass code. Pass codes shall consist of up to ten (10) digits. Changes to pass codes shall only be made by Level 3 authorized personnel.
 - a. When entering a pass code, the digits entered shall not be displayed. All key presses shall be acknowledged by a local audible sound and/or visual "*" in the 80 character display.
 - b. When a correct pass code is entered, the new access level shall be in effect until the operator manually logs out or the keypad has been inactive for ten (10) minutes.
 - c. Should an invalid code be input, access shall be denied.
 - d. Access to a level shall only allow the operator to perform all actions within that level plus all actions of lower levels, not higher levels.
 - e. The following keys/switches, or their equivalent shall have access levels associated with them:
 - Set time/date.
 - Manual control
 - Disable/enable
 - Clear historical alarm log
 - Clear historical trouble log
 - Walk test

- Change alarm verification
- f. The following keys/switches shall not be pass code protected and shall be protected by the lockable enclosure:
Alarm Silence
System Reset
Acknowledge
19. The fire alarm system shall allow for loading and editing special instructions and operating sequences as required. The system shall be capable of being reprogrammed to accommodate system expansion and facilities changes in operation. All software operations shall be stored in a non-volatile programmable memory within the fire alarm control panel. Loss of primary and secondary power shall not erase the instructions stored in memory.
20. Resident software shall allow for full configuration of initiating circuits so that additional hardware shall not be necessary to accommodate changes in, for instance, sensing of normally open contact devices to sensing of normally closed contact devices, or from sensing of normally open contact devices to sensing a combination of current limited and non-current limited devices on the same circuit and being able to differentiate between the two, or changing from a non-verification circuit to a verification circuit or vice-versa.
21. Resident software shall also allow for configuration of indicating appliance and control circuits so that additional hardware shall not be necessary to accommodate change in, for instance changing a non-coded indicating appliance circuit to a coded circuit.
22. The main fire alarm panel shall have the resident ability to store a minimum of 600 system events in chronological order of occurrence. Event history shall include all system alarms, troubles, operator actions, unverified alarms, circuit/point alterations, and component failures. Events shall be time and date stamped. Events shall be stored in non-volatile buffer memory. Access to history buffer shall be secured via 5-digit password security code. The system shall have the capability of recalling alarms and trouble conditions in chronological order for the purpose of recreating an event history. Loss of primary or secondary power shall not erase the events stored in the memory. Each recorded event shall include the time and date of that event's occurrence.
- a. The following Historical Alarm log events shall be stored:
Alarms
Alarm acknowledgment
Alarm silence
System reset
Alarm historical log cleared
- b. The following historical trouble log events shall be stored:
Trouble conditions
Supervisory alarms
Trouble acknowledgment
Supervisory acknowledgment
Alarm verification tallies
Walk tests results
Trouble historical log cleared
23. Alarm verification shall be by device, whereby only verification from the same device will confirm the first activation and cause the alarm sequence to occur.
24. The control panel shall have the capability to display the number of times (tally) a device has gone into a verification mode. Should this verification tally reach a pre-programmed number, a trouble condition shall occur.
25. The control panel shall have a dedicated supervisory service LED and a dedicated supervisory service acknowledge key. Pressing the supervisory service acknowledge key shall silence the supervisory audible signal while maintaining the supervisory service LED "ON" indicating the off-normal condition.

26. Activation of an auxiliary bypass key shall override the selected automatic functions.
 27. The system shall have keys that will allow the operator to display all alarms, troubles, and supervisory service conditions including the time of each occurrence.
 28. RS-232-C output: the fire alarm control panel shall be capable of operating remote generic consumer type printers; output shall be ASCII from an EIA RS-232-C connection with an adjustable baud rate. Each RS-232-C port shall be capable of supporting and supervising a remote display and printer. Data amplifiers shall be used to increase data line distance when required.
 29. Panel shall be sized to accommodate all required equipment. Panel shall be equipped with locks and transparent door, providing freedom from tampering yet allowing full view of the various displays and controls.
- T. The fire alarm control panel shall have a 25% spare initiating point and battery capacity for future use.
- U. The power supply shall provide all control panel and peripheral power needs with filtered power as well as unregulated 24VDC power for external audio-visual devices. The audio-visual power shall be increased as needed by adding additional modular expansion power supplies. All power supplies shall be designed to meet UL and NFPA requirements for POWER-LIMITED operation on all external signaling lines, including initiating circuits and indicating circuits. Design the system power supplies and power trunk wiring for all annunciation devices required, and to add a minimum of five (5) 110cd visual devices in the future. Individual design loading shall not exceed 70% of power supply and system wiring capacity.
1. Input power shall be 120VAC 60Hz. The power supply shall provide internal supervised batteries and automatic charger. The power supply shall provide positive and negative ground fault supervision, battery/charger fail condition, AC power fail indicators. The power supply shall also provide supervision of modular expansion power supplies as may be required.
 2. Surge protection shall be integral to the control panels.
 3. Each power supply shall be monitored and have an individual address.
- V. Monitoring modem interface:
- 1 Existing to remain. Verify proper functionality.
- W. Not Used
- X. Detector sensitivity shall be programmable from the control panel from the following sensitivities: 0.5, 1.0, 1.5, 2.0, 2.5, 3.0 and 3.7% obstruction. Detectors shall be able to be programmed to alert a trouble signal at a lower obstruction and shall report an alarm if the smoke density increases to a predetermined set point. Control Panel and Detectors shall be capable of "Day-Night" automatic sensitivity adjustments.
- Y. Control Switches:
1. Acknowledge/step Switch
 2. Signal Silence Switch
 3. System Reset Switch
 4. System Test Switch
 5. Lamp Test
- Z. Automatic Detector Test: The system shall include a special automatic detector test feature, which permits reading and adjustment of the sensitivity of all intelligent detectors from the main control panel. An automatic detector test shall occur automatically fourteen times each twenty-four hour period or be initiated manually from the FACP as desired. In

addition, the automatic test feature shall also permit the functional testing of any "intelligent" detector or addressable interface device individually from the main control panel. Automatic detector test sequencing shall be terminated upon receipt of an alarm condition. Detector test shall report all unprogrammed devices installed and report all programmed devices not installed.

AA. Emergency voice alarm communication system:

1. The emergency voice and tone communication system shall be a pre-built system and shall only require two wires from a polarity reversal circuit or a dry contact for activation. It shall supervise the NO dry contact (if used) and provide a form C trouble relay activation in the event of a system fault. The Voice Communication System shall incorporate minimum 50 watts true RMS amplifiers for both tone and speech amplification. The system shall have a load capacity of up to 100 watts. Optionally, the Voice Communication System shall be capable of providing 50 watts of audio with full backup. The Voice Communication System shall be capable of operating as a stand-alone system or follow the activation of the fire alarm/suppression system. The Voice Communication System shall include a regulated power supply and shall be capable of charging and housing its own batteries. There shall be no need to calculate the load requirements or draw any energy from the fire alarm/suppression system. The Voice Communication System shall come with one speaker supervisory zone as a standard and shall be capable of supervising any combination of up to 11 speaker and/or strobe monitoring modules.
2. A full set of control switches including an all call, tone interrupt, trouble silence and reset shall be available at the Voice Communications System. The Voice Communications System control panel shall also have a green POWER ON LED, a red ALARM LED, a yellow BROWN OUT LED and a yellow SYSTEM TROUBLE LED.
3. The Voice Communication System shall be able to detect a short on any speaker or strobe zone during the normal and alarm mode. The shorted zone shall be isolated from the system and a dedicated LED on the supervised zone shall indicate the short circuit condition. The system shall produce an audible and visual signal indicating that a trouble condition has occurred. Similarly an open circuit shall create a trouble condition and corresponding LED annunciation at the affected zone and at the main control module. Zones that are not shorted or opened shall remain operational.
4. The Voice Communications System shall be able to detect a brownout condition on the AC supply. In the brownout condition the Voice Communication System shall activate a dedicated LED and an audible trouble signal. Ground faults shall activate the system trouble LED and the audible trouble signal, as well as specific LEDs indicating negative and positive ground faults.
5. The Voice Communication System shall be field configurable for 25 or 70.7 volt RMS audio output via program jumpers.
6. The Voice Communication System shall have a digital message player / recorder. The digital message player / recorder shall be capable of storing alert and evacuation tones as well as an emergency voice message. It shall be possible to modify the digital message and tones in the field using a built-in acoustic microphone or headphone jack connected to an audio device. There shall be no need for the burning of eproms in order to program the digital message player / recorder. The digital message player / recorder shall be supervised by the Voice Communication System. The Voice Communications System shall provide a backup evacuation tone in the event of a digital message player / recorder failure.
7. An alarm condition shall cause an audible signal and a red LED to activate. A Voice Communication System with a digital message player / recorder shall produce an ALERT tone followed by an emergency voice message, and in turn

followed by an ALARM tone. The number of tone repetitions shall be configurable by the setting of DIP switches on the digital message player / recorder.

8. The sheet metal enclosure shall include a hinged deadfront allowing easy access to all the Voice Communication System components for the purposes of wiring, setting the system configuration and servicing. A door with a key lock shall be part of the Voice Communication System enclosure.

2.4 FIELD DEVICES

- A. All devices shall be supervised for trouble conditions. The fire alarm control panel shall be capable of displaying the type of trouble condition (open, short, device missing/failed). Should a device fail, it shall not hinder the operation of other system devices.
- B. Visual Signals:
 1. Strobe lights shall be of the electronic flashing xenon strobe type and operate on 24 VDC. The strobe light shall be capable of producing 75 candela on axis to comply with ADA and UL 1638 requirements, and 15, 30, or 110 candela to comply with UL 1971 requirements. Visual signals in common areas of illumination shall have synchronized flash. Provide white with red letters.
 2. If required to be mounted in student toilets / restrooms, gymnasiums, student locker / dressing rooms shall have a protective cover.
- C. Combination Alarm Signal and High Intensity Visual Signals:
 1. Strobe lights shall be of the electronic flashing xenon strobe type and operate on 24 VDC. The strobe light shall be capable of producing 75 candela on axis to comply with ADA requirements, and 15, 30 or 110 candela to comply with UL 1971 requirements. Visual signals in common areas of illumination shall have synchronized flash. Each unit shall provide a Code 3 Temporal tone. The horn shall be capable of an output of 95dB at 10', and intensity adjusted accordingly for the area of coverage. Electronic Mini-Sounder or horn set on low setting shall be provided in interior rooms 900 square feet or less. Mini-sounder shall not be used in any corridors, mechanical electrical rooms and similar large spaces and areas of high ambient noise level. Provide white with red letters.
 2. All combination audio / visual devices mounted in student toilets / restrooms, gymnasiums, and student locker / dressing rooms shall have a protective cover.
 3. The audible emergency alarms shall produce a sound that exceeds the prevailing sound level in the room or space by at least 15 dba or shall exceed any maximum sound level with a duration of 60 seconds by 5 dba, whichever is louder with or without protective cover. Sound levels for alarm signals shall not exceed 110 dba at the minimum hearing distance from the audible appliance.
- D. Exterior Audible / Visual Signal:
 1. Provide semi-flush mounted, molded of high impact red thermoplastic and listed for exterior weatherproof locations.
- E. Combination Voice Signal and High Intensity Visual Signals:
 1. Strobe lights shall be of the electronic flashing xenon strobe type and operate on 24 VDC. The strobe light shall be capable of producing 75 candela on axis to comply with ADA requirements, and 15, 30 or 110 candela to comply with UL 1971 requirements. Visual signals in common areas of illumination shall have synchronized flash.
 2. If required to be wall mounted in student toilets, gymnasiums, corridors, student locker / dressing rooms, provide wire guard protective cover.
 3. The visual signal lens housing shall be white with red lettered FIRE or as approved by Architect. The speaker and visual signal shall be mounted to a common white speaker baffle. The visual signal shall flash at a rate of minimum

- of 1 Hz and maximum of 3 Hz, and shall use a xenon strobe type lamp or other high intensity long life light source. The lamp intensity shall be a minimum of 75 candela.
4. The speaker shall be UL 1480 compatible with the control equipment. Unit shall operate within a temperature range of 150°F to -30°F. High output speakers, UL minimum 87dB at 10 feet with speaker taps of .33.66/1.25/2.5 watts. Standard output speakers, UL 75-81 dB at 10 feet with speaker taps of .5/1/1.75/2.75 watts. Capacitor for line supervision.
- F. Ceiling mounted recessed mounted speakers shall be UL 1480 compatible with the control equipment. Unit shall operate within a temperature range of 150°F to -30°F. UL minimum 78-87 dB at 10 feet with speaker taps of .25, .5/1.0/2.0 watts. Round, white baffle in gypboard or plaster ceilings, provide 2x2 lay-in grid with UL enclosure, tile bridge supports when recessed in lay-in ceiling tiles Capacitor for line supervision.
- G. Surface mounted speakers shall be UL 1480 compatible with the control equipment. Unit shall operate within a temperature range of 150°F to -30°F UL minimum 100 dB at 15 watts at 10 feet. Speaker taps via 7-position selector switch, 25-vol., .48/.94/1.8/7.5/15 watts. Fully enclosed wiring terminals. Capacitor for line supervision. Raco #911 Series Life Safety Appliance back box and adapter, or appliance manufacturer back box.
- H. Addressable Manual Pull Stations:
1. The manual station shall provide address-setting means using rotary decimal switches. No binary coding shall be required.
 2. Manual stations shall be designed for semi-flush mounting on standard electrical box. The station shall be constructed of hi-impact red molded Lexan with instructions for station operation in raised white letters. Stations shall be of the dual action type.
 3. Install Stopper STI1100 series covers with horns on all manual pull stations, except at the FACP and Remote Annunciator.
 4. Do not specify or use ionization only type detectors unless reviewed and approved by CFISD. Multi-criteria detectors that include ionization detection as one of the criteria to initiate and alarm are acceptable.
 - 5.
- I. Intelligent Photoelectric Smoke Detectors:
1. The detectors shall use the photoelectric principal to measure smoke density and shall, on command from the control panel, send data to the panel representing the ANALOG level of smoke density. The detector shall provide automatic sensitivity "drift" compensation. The detector shall also provide a "maintenance alert" feature whereby the detector shall initiate a trouble condition should the unit's sensitivity approach the outside limits of the normal sensitivity window.
 2. The detectors shall provide address-setting means electronically and automatically at the control panel and programmed for alarm verification.
 3. The detectors shall provide operational status and alarm state LED. Under normal conditions, the LED shall flash, indicating the detector is operational and in regular communication with the control panel. An output connection shall also be provided in the base for connecting an external remote alarm LED.
 4. The detector shall be semi-flush ceiling mounted and be provided with modular detector head with twist-lock base. No radioactive material shall be used.
 5. Voltage and RF transient suppression techniques shall be employed as well as smoke signal verification circuit and an insect screen.
- J. Duct photoelectric smoke detectors:
1. Detectors shall be analog addressable type.
 2. To minimize nuisance alarms, detectors shall have an insect screen and be

- designed to ignore invisible airborne particles or smoke densities that are below the factory set alarm point. No radioactive material shall be used.
3. Removal of the detector head shall interrupt the supervisory circuit of the fire alarm detection loop and cause a trouble signal at the control panel.
 4. Voltage and RF transient suppression techniques shall be employed as well as smoke signal verification circuit and an insect screen.
 5. Remote alarm/power LED indicator with test switch shall be provided. Unit shall be wall or ceiling mounted in readily visible and accessible area near the location of detector; exact location of unit to be approved by the Architect/Engineer.
 6. Detectors shall operate on the same principles and exhibit the same basic characteristics as area type photoelectric smoke sensors. The detector shall operate in air velocities of 300 FPM to 4,000 FPM. Each detector shall interface directly to the system SLC loop without the requirement of interface zone modules.
 7. The unit shall consist of a clear molded plastic enclosure (or remote mounted LED status indicator shall be provided next to the smoke detector) with integral conduit knockouts to provide visual viewing of detector/sensor for monitoring sensor operation and chamber condition. The duct housing shall be provided with gasket seals to insure proper seating of the housing to the associated ductwork. Each unit's sampling tubes shall extend the width of the duct and be provided with porosity filters to reduce sensor/chamber contamination.
 8. The detectors shall provide alarm and power status indication by LED. Under normal conditions, the LED shall flash, indicating the detector is operational and in regular communication with the control panel. Steady illumination of the LED shall indicate that the control panel has detected and verified an alarm condition. An output connection shall also be provided in the base for connecting an external remote alarm LED.
 9. The detectors shall provide address setting means electronically and automatically from the control panel and programmed for alarm verification.
- K. Intelligent Thermal Detectors:
1. The detectors shall use dual electronic thermostats to measure temperature levels in its chamber and shall, on command from the control panel, send data to the panel representing the analog temperature level.
 2. The detectors shall provide address-setting means electronically and automatically at the control panel.
 3. The detectors shall provide operational status and alarm state LED. Under normal conditions, the LED shall flash, indicating the detector is operational and in regular communication with the control panel. An output connection shall also be provided in the base for connecting an external remote alarm LED.
 4. The detector shall be semi-flush ceiling mounted and be provided with modular detector head with twist-lock base.
 5. Thermal Detectors shall be combination rate-of-rise and fixed-temperature- rated at 135°F for areas where ambient temperatures do not exceed 100°F and shall be 200°F for areas where ambient temperatures exceed 100°F but not 150°F. The fixed temperature element shall consist of a fusible alloy retainer and actuator shaft. Detectors shall have a smooth ceiling rating of 2,500 square feet. Detectors shall be located as specified and where required by local code authority.
 6. Provide fixed temperature 190°F detector in kitchen and kiln room in lieu of combination rate-of-rise / fixed-temperature type.
- L. Addressable Carbon Monoxide Detection:
1. System sensor #CO1224 with addressable identification of the CO Detector's alarm and trouble contact status. UL listed to Standard 2075 Standard for Gas

- and Vapor Detectors and Sensors.
 - 2. Unit to be powered by the fire alarm system non-resettable 24 VDC supervised power supply.
 - 3. Electro-chemical CO detection.
 - 4. Integral 85db local alarm with local hush/test switch for silence or test.
 - 5. Alarm contacts and trouble contacts for detector trouble, loss of power, and end of life.
- M. Auxiliary AHU Relays: Air Products model MR-101C relays shall be provided for HVAC and AHU control and interface. Relays shall be heavy-duty type with contacts rated up to 10 amps at 120V AC, 60 HZ. Relays shall be provided with NEMA I dust cover assembly and be provided with DPDT contacts as well as activated LED indicator.
- N. Voltage sensing relays: Addressable control modules for voltage sensing relay interface shall be FCM-1.
- O. Monitor Module:
- 1. Addressable monitor modules shall be provided where required to interface to contact alarm devices.
 - 2. The monitor module shall provide address-setting means electronically and automatically at the control panel. A status/alarm LED shall be provided which shall indicate that the monitor module is operational and in regular communication with the control panel, and indicate detection of an alarm condition.
- P. Control Module
- 1. Control/relay modules shall be provided where required to provide audible alarm interface and/or relay control interface. The control module may be optionally wired as dry contact (form C) relay.
 - 2. The control module shall provide address-setting means electronically and automatically at the control panel. A status/alarm LED shall be provided which shall indicate that the control module is operational and in regular communication with the control panel and indicate when the device is actuated via the fire alarm control panel.
- Q. Auxiliary Interface Points: All auxiliary input points (fire suppression hoods, water flow, fire pump, AHU shut-down points, tamper switches, fire extinguishing systems etc.) shall be connected as required, and addressed as a separate initiating point of annunciation at the fire alarm panel and any remote annunciator as required.
- R. Water flow switches / Valve supervisory switches shall be provided and installed by the fire protection contractor and connected by the fire alarm contractor. Wiring of these field devices to the fire alarm system shall be the responsibility of the fire alarm contractor. It is the responsibility of this contractor to ensure the proper function of the system. Each fire protection zone (flow switch) and (Valve switch) shall be addressed electronically and automatically at the control panel as a separate point of annunciation at the fire alarm panel. Coordinate exact location with fire protection contractor and civil drawings.
- 2.5 VESDA – VERY EARLY WARNING ASPIRATING SMOKE DETECTION SYSTEM
- A. Approved Manufacturers:
- 1. System Sensor (FASAST) – Detection devices for Cooler / Freezer areas 200 square feet or larger, atriums / high ceiling areas with difficult access.
 - 2. Xtralis (VESDA) – Detection devices for Cooler / Freezer areas 200 square feet or larger, atriums / high ceiling areas with difficult access.

- B. A Very Early Warning Smoke Detection System similar to the VESDA VLI System shall be installed throughout the cooler and freezer storage areas 200 square feet and larger, and as an alternative to beam type detectors at high ceiling areas with difficult access.. The system shall consist of highly sensitive LASER-based Smoke Detectors with aspirators connected to networks of sampling pipes, intelligent filtration arrangement with fail-safe operation, sub-sampling probe (inertial separator), built-in clean air zero capability, local USB configuration port and Ethernet networking port. VESDA detection system shall be networked with the specified Notifier Fire Alarm Control Panel.
- C. Design Requirements
1. The system shall consist of an air sampling pipe network to transport air to the detection system, supported by calculations from a computer-based design modeling tool.
 2. It shall be tested and approved to cover up to 2,000m² (20,000 sq.ft).
 3. It shall have a built-in simple user interface indicating alarm and fault status and include a reset / disable button.
 4. It shall provide absolute smoke detection.
 5. It shall be approved to provide very early warning smoke detection and provide four alarm levels corresponding to Alert, Action, Fire 1 and Fire 2. These levels shall be programmable and able to be set at sensitivities ranging from 0.05-20% obs/m (0.016–6.4% obs/ft.).
 6. The detector shall be specifically designed for industrial applications.
 7. It shall consist of a highly sensitive LASER-based smoke detector with in-field clean air zero capability, aspirator, intelligent filter and secondary filter.
 8. It shall be modular, with field replaceable detection chamber, aspirator, intelligent filter and secondary filter.
 9. It shall have four pipe inlets for sample air.
 10. It shall incorporate per pipe ultrasonic flow monitoring and provide staged airflow faults.
 11. It shall have a built-in and field replaceable intelligent filter placed after the flow monitoring circuitry.
 12. Intelligent filter shall:
 - a. Dilute the sampled air for prolonged detector life.
 - b. Combine sample air from all pipe inlets.
 - c. Divide sampled air into filtered clean air and unfiltered air before mixing them together.
 - d. Use HEPA filter with more than 99% efficiency for filtered clean air i.e. removing more than 99% of contaminant particles of 0.1microns or larger, to provide clean air for dilution.
 - e. Use a mesh/screen for the unfiltered air for protection against lint type of particles.
 - f. Be fail-safe and supervised for correct operation with built-in capability to alert for when replacement is required.
 - g. Maintain consistent detector sensitivity over time.
 - h. Have ultrasonic airflow monitoring of the unfiltered sampled air through the intelligent filter.
 13. It shall have a field replaceable aspirator after the intelligent filter where the diluted sampled air flows through the aspirator prolonging its life.
 14. The aspirator shall be a purpose-designed rotary vane air pump. It shall be capable of allowing for multiple sampling pipe runs up to 360m (1,200ft) in total, (4 pipe runs per detector) with a transport time per applicable local codes.
 15. It shall have a sub-sampling probe (inertial separator) after the aspirator for reduced dust intake in to the detection chamber.
 16. It shall have a secondary foam filter after the sub-sampling probe (inertial separator) where the sub-sampled air flows through the foam filter prolonging detection chamber life. The foam filter shall be capable of filtering particles in

17. It shall have a field replaceable smoke detection chamber which stores the calibration values with the chamber assembly.
 18. It shall have capability for in-field clean air zero to provide absolute smoke detection.
 19. It shall have capability to measure blockages in the air path in to or out of the detection chamber.
 20. It shall have an enclosure rating of IP54.
 21. The detector shall allow for direct wall mounting or using a supplied mounting plate.
 22. It may be inverted as required in specific applications.
 23. It shall be self-monitoring for filter contamination.
 24. It shall be configured via local USB port with Ethernet port for remote monitoring.
 25. It shall have Fire and Fault relay outputs in addition to three configurable relays. The relays shall be software programmable to the required functions and must be rated at 2 AMP at 30 VDC.
 26. It shall have at least one general purpose input (GPI).
 27. It shall have Power In and Power Out connections to allow powering more than one detector from one power supply.
 28. Optional equipment may include a dedicated Xtralis VSM graphics package.
 29. It shall report any fault on the unit by using configurable fault relay outputs or via PC based configuration and monitoring system.
 30. The detector shall have built-in event and smoke logging. It shall store smoke levels, alarm conditions, operator actions and faults. The date and time of each event shall be recorded. Each detector (zone) shall be capable of storing up to 18,000 events.
- D. Programming Requirements
- Using either USB or Ethernet port the detector shall allow programming of:
1. IP address and related fields to support Ethernet based networking
 2. Four smoke threshold alarm levels
 3. Time delays
 4. Configurable relay outputs for remote indication of detector conditions
 5. Holidays and day/night changeover times
 6. Major and minor airflow fault limits
 7. Aspirator speed
 8. General purpose input function
 9. Alarm and fault latching
- E. Sampling Pipe
1. The sampling pipe shall be smooth bore. Normally, pipe with an outside diameter (OD) of 25mm or 1.05" and internal diameter (ID) of 21mm or ¾" should be used.
 2. The pipe material should be suitable for the environment in which it is installed. VESDA pipe material shall be UL 1887 Plenum rated CPVC).
 3. All joints in the sampling pipe must be air tight and made by using solvent cement, except at entry to the detector.
 4. The pipe shall be identified as Air Sampling/Aspirating Smoke Detector Pipe along its entire length at regular intervals not exceeding the manufacturer's recommendation or that of local codes and standards.
 5. All pipes shall be supported at not less than 1.5m (5ft) centres, or that of the local codes or standards.
 6. The far end of each trunk or branch pipe shall be fitted with an end-cap and made air-tight by using solvent cement. Use of an end-cap will be dependent on ASPIRE2 calculations.

- F. Sampling Holes
1. Sampling holes shall not be separated by more than allowed for conventional point detectors as required by 30 feet as local codes and standards. Intervals may vary according to calculations. For NFPA the maximum allowable distance is 30ft.
 2. Each sampling point port shall be identified in accordance with Codes or Standards.
 3. Provide per manufacturer's recommendations and standards in relation to the number of sampling points and the distance of the sampling points from the ceiling or roof structure and forced ventilation systems.
 4. Sample port size shall be as specified by ASPIRE2 calculations.
- G. Detection Alarm Levels:
The laser-based ASD system shall have four (4) independently programmable alarm thresholds. The four alarm levels may be used as follows:
- Alarm Level 1 (Alert)
Activate a visual and audible alarm in the fire risk area.
- Alarm Level 2 (Action)
Activate the electrical/electronic equipment shutdown relay and activate visual and audible alarms in the Security Office or other appropriate location.
- Alarm Level 3 (Fire 1)
Activate an alarm condition in the Fire Alarm Control Panel to call the Fire Monitoring Service and activate all warning systems.
- Alarm Level 4 (Fire 2)
Activate a suppression system and/or other suitable countermeasures.
- The alarm level functions as listed are possible scenarios. Program as directed by Owner to the best utilization of these facilities for each application and the requirements of local A.H.J.
- H. Initial Detection Alarm Settings
- | | |
|---------------------------|------------------------------|
| 1. Alarm Level 1 (Alert) | 0.2% obs/m (0.064% obs/ft.) |
| 2. Alarm Level 2 (Action) | 0.3% obs/m (0.096% obs/ft.) |
| 3. Alarm Level 3 (Fire 1) | 0.40% obs/m (0.128% obs/ft.) |
| 4. Alarm Level 4 (Fire 2) | 2.0% obs/m (0.64% obs/ft.) |
- I. Initial (factory default) Alarm Delay Thresholds
Initial (factory default) settings for the alarm delay threshold shall be:
- | | |
|---------------------------|------------|
| 1. Alarm Level 1 (Alert) | 10 seconds |
| 2. Alarm Level 2 (Action) | 10 seconds |
| 3. Alarm Level 3 (Fire 1) | 10 seconds |
| 4. Alarm Level 4 (Fire 2) | 10 seconds |
- J. Fault Alarms: The Detector Fault relay shall be connected to the appropriate alarm zone on the Fire Alarm Control Panel (FACP) in such a way that a Detector Fault would register a fault condition on the FACP. The Minor Fault and Isolate relays shall also be connected to the appropriate control system. Provide as required by local Codes, Standards or Regulations.
- K. Power Supply and Batteries: The system shall be powered from a regulated supply of nominally 24V DC. The battery charger and battery shall comply with the relevant Codes, Standards or Regulations. Typically 24 hours standby battery backup is required followed by 30 minutes in an alarm condition.
1. UL 1481 Listed -provided the power supply and standby batteries have been appropriately sized / rated to accommodate the system's power requirements.
 2. Provide 120-volt 20-amp circuit from the life safety branch panel to each power supply.

2.6 AUXILIARY EQUIPMENT MONITORING

- A. The fire alarm system shall monitor for alarm, supervisory, and trouble conditions; and annunciate the status of the following equipment when provided, or is existing to remain, as part of this project. A failed status shall activate the trouble alarm.
1. Emergency Generator: Run Status
 2. Emergency Generator: Trouble Signal
 3. Fire Pump: Run Status
 4. Fire Pump: Trouble Signal
 5. Emergency Service Communications Systems, as required by NFPA 72 and NFPA 1221.

2.7 MAGNETIC DOOR HOLDERS, AUTOMATIC FIRE DOORS / SHUTTERS, AND SECURITY GRILLES AND INTERIOR SPACE CONTROLLED ACCESS EGRESS DOORS WITH AUTOMATIC EMERGENCY EGRESS ELECTRIC LOCK EMERGENCY RELEASE

- A. Magnetic fire door hold open devices, interface for automatic roll down fire doors/shutters, and interface for security grilles and controlled access egress doors with emergency egress shall be provided. Coordinate with Division 8 and Architectural Drawings for exact location.
- B. The operation of any alarm in the fire alarm system shall cause the following:
1. Release of the magnetic fire door holding devices, permitting the fire doors to be closed by the door closer.
 2. Permit the automatic roll down fire doors/shutters to close automatically.
 3. Permit the security grilles with emergency egress to open automatically.
 4. Unlock the electrically controlled access doors in all interior spaces.
- C. The magnetic door holders, automatic roll down fire doors/shutters, security grilles, and interior electrically controlled access doors with emergency egress, shall be associated with two smoke detectors located on the ceiling with one on either side of the fire door/shutter, security grille opening, or interior egress path electrically controlled door. The operation of either of these detectors shall also cause the magnetic holder to release the fire door, the automatic fire door/shutter to close, and the security grille with emergency egress to open.
- D. The operation of smoke detectors associated with a magnetic door holder, automatic roll down fire door, security grille, or electrically controlled access door shall transmit a pre-alarm signal to the fire alarm panel.

2.8 REMOTE ALPHA-NUMERIC DISPLAY ANNUNCIATORS

- A. Remote alpha-numeric annunciator(s) to annunciate all system events and duplicate the displayed status at the main FACP. The annunciator(s) shall be an alphanumeric display similar to the main FACP and operate via the system RS485 or RS232 serial output terminal from the main FACP. The unit shall operate from FACP 24VDC power and function during system power failure while the system resides on standby batteries. The remote annunciator(s) shall include:
1. Integral time-date clock
 2. System reset
 3. System silence
 4. System acknowledge
 5. Display/step switch
 6. Integral trouble buzzer
 7. LCD contrast adjust

8. Fire Drill Operation

- B. Annunciator shall upon command display the first system alarm, last alarm, and system alarm count. The following primary controls shall be visible through a front access panel:
1. 80 character alphanumeric display, LCD, LED, or gas plasma
 2. Individual red system alarm LED
 3. Individual yellow supervisory service LED
 4. Individual yellow trouble LED
 5. Green "POWER ON" LED
 6. Alarm acknowledge key
 7. Trouble acknowledge key
 8. Alarm silence key
 9. System reset key
 10. LED test

2.9 REMOTE PAGING UNIT

- A. Remote all-call paging unit or to activate one of the pre-recorded messages over the speaker circuits.

2.10 PRINTER AND PRINTER STAND

- A. Printer and printer stand not required by owner.

PART 3 – EXECUTION

3.1 GENERAL REQUIREMENTS

- A. Installation shall include the delivery, storage, setting in place, fastening to the building structure, interconnection of the system components, alignment, adjustment and all other work, whether or not expressly specified, which is necessary to result in a tested and operational system.
- B. All installation practices shall be in accordance with, but not limited to, the specifications and drawings. Installation shall be performed in accordance with the applicable standards, requirements and recommendations of NFPA 72 and the National Electrical Code and any authorities having jurisdiction. Proper protection against corrosion shall be provided on all electrical equipment in accordance with the requirements of the National Electrical Code. The installation shall conform to all manufacturers' recommendations.
- C. All equipment shall be firmly secured in place unless requirements of portability dictate otherwise. Fastenings and support shall be adequate to support their loads with a safety factor of at least three.
- D. All boxes, equipment, etc., shall be plumb and square. The contractor must take such precautions as are necessary to prevent and guard against electrostatic hum, to supply adequate ventilation, and to install the equipment to provide reasonable safety for the operator.
- E. In the installation of equipment and cables, coordinate with Architectural drawings for possible conflicts with millwork, casework, marker boards, furniture, lockers, etc., and notify the architect of any discrepancies. Verify modifications before proceeding with installation.
- F. Mount end-of-line resistor for each box circuit in backbox located at the last manual alarm station or automatic initiating device in a circuit. Mark device accordingly in the field.

- G. Provide three dedicated Cat 6 cables from MDF/IDF to fire alarm panel. Cable shall be installed in 3/4" conduit. Two cables for phone POT lines and one Ethernet data connection.
- H. Upright and/or Wall Post-Indicating Valve: Provide conduit and wiring from fire alarm control panel to post-indicating valve if electronically supervised, coordinate exact location of PIV with fire sprinkler contractor prior to rough-in. Coordinate final location with Civil Drawings and Fire Protection Contractor. Where equipment is located inside a vault, stub required conduit inside vault, turn up and cap.
- I. Contractor shall submit on completion of system verification, a point-by-point check list indicating the date and time of each item inspected and issue a certificate confirming that the inspection has been completed and the system is installed and functioning in accordance with the Specifications prior to date of substantial completion.
- J. Provide remote alphanumeric display annunciators in the administrative area in constantly attended area and additional annunciators where indicated on the drawings.
- K. Provide remote paging units adjacent to each remote alphanumeric display annunciator for voice alarm systems.
- L. Alarm devices shall be ceiling mounted unless indicated specifically otherwise. Alarm devices in Mechanical, Electrical, Communications, IDF / MDF Rooms and Central Plant shall be wall mounted and coordinated with other equipment, piping and ductwork.
- M. Provide combination speaker strobes. Provide strobe only alarms when additional speaker placement will compromise voice intelligibility. Provide horn/strobes in coolers and freezers.
- N. Detectors shall be installed per NFPA 90A and be listed with the fire alarm control panel.
- O. Auxiliary Equipment Monitoring Wiring and connection to equipment shall be the responsibility of the fire alarm contractor.
- P. Power for magnetic door holders shall be wired through fire alarm relay.
- Q. Smoke detectors shall be mounted to a 4-inch octagon box with hanger bar or with box secured to building structure.
- R. Provide power via 120-volt, 20-Amp dedicated circuits with lock-on provisions at the respective circuit breaker for the main fire alarm control panel, each panel extender and each remote power supply at no additional cost to the Owner. The complete fire alarm system shall be powered under emergency power when emergency life safety power is available at the project site. When emergency life safety power is not available at the project site, power shall originate from the nearest available 120-volt panel. Label 120V circuit origination (i.e.: "120-Volt Circuit ELA-3")
- S. Provide smoke detectors in the following locations:
 - 1. All paths of egress and adjoining spaces within the same HVAC envelope including but not limited to: corridors, hallways, stairs, lobbies, and elevator landings.
 - 2. At each electrical room, telecommunications/data room, elevator machine room, kiln room, and mechanical room not subject to un-treated or un-filtered outside air.
 - 3. At each computer lab/room.
 - 4. At each library, library office and library ancillary areas.
 - 5. At each storage room, stock room, or warehouse space.

6. At each pre-K and kindergarten classrooms.
 7. At nurse's area/clinic and patient care/cot areas.
 8. At each men's and women's restroom/toilet
 9. At each administrative work room or copy room.
 10. At each student toilet / restroom. Provide STI protective cover. Do not locate over plumbing fixtures or near partitions.
 11. At each special needs, life skills, adaptive behavior, developmental classrooms or similar designated areas without food preparation or cooking equipment.
- T. Provide heat/thermal detectors in the following locations:
1. At each electrical room, telecommunications/data room, elevator machine room and mechanical room subject to un-treated or un-filtered outside air.
 2. At each janitor's/custodial closets and laundry rooms.
 3. At each commercial kitchen and adjoining storage rooms; at each food preparation area.
 4. At each employee break room/lounge.
 5. At each vocational shop.
 6. At each science, physics, chemistry, or biology classroom and their associated preparation and storage rooms.
 7. At each special needs, life skills, adaptive behavior, developmental classrooms or similar designated areas with food preparation or cooking equipment.
- U. Provide carbon monoxide detection and smoke detection devices in all areas designated as day-care for minors.
- V. Provide duct smoke detectors in all air handling units with air volumes of 2,000 cfm or larger. Where duct smoke detectors are installed above ceilings, provide external remote status/alarm LED mounted flush with ceiling in close proximity to the duct detector location. If space is open without ceiling, wall mount remote status/alarm LED in close proximity to the detector between 96 and 108-inches AFF, or as directed by Owner.
- W. Provide duct smoke detectors on outside air units only as required by local Code and / or A.H.J.
- X. Provide VESDA type detectors at the following locations when appropriate:
1. Atriums.
 2. High ceiling corridors where maintenance of spot type detectors may be difficult.
 3. Areas with skylights.
- Y. Provide manual pull stations at FACP in MDF and adjacent to Fire Alarm Annunciator(s) only, unless required by code otherwise.
- Z. Provide weatherproof exterior audio/visual alarm devices mounted on the building at the exact location as directed by Architect:
1. Main entry.
 2. Courtyards and outdoor assembly areas adjacent to the building.
 3. Mechanical yards adjacent to the building.
 4. Covered playgrounds or covered assembly areas adjacent to the building.
 5. Additional locations where indicated on drawings.
 6. Outdoor paved play areas.
- AA. Provide audio and visual alarm devices in all areas normally occupied by students or minors and all common use areas.
- BB. Provide carbon monoxide detection in classrooms and other instructional spaces served by a fuel-burning appliance, fuel-burning HVAC equipment (including roof mounted

equipment), or with gas fuel outlets for connection to portable fuel-burning space heaters and appliances such as Bunsen burners which are typically used in laboratories or science classrooms.

- CC. Provide smoke detectors, pull stations with stopper covers, and speaker strobes in each classroom in all portable buildings, tied into the main campus fire alarm control panel.
- DD. Provide properly rated and grounded surge suppression for all circuits leaving and entering the building.

3.2 CABLE AND BOXES INSTALLATION

- A. All fire alarm wiring to be red. All fire alarm circuits shall be identified at each termination and at each 25 feet between terminations. Minimum Wire size shall be as follows:
 - 1. Initiating Circuits: 18 AWG
 - 2. Strobe Circuits: 14 AWG
 - 3. Relay Control Circuits: 18AWG
 - 4. Voice/Speaker Circuits: 16 AWG
- B. All circuits shall be protected to avoid interruption of service due to short-circuiting or other conditions, which might adversely affect the connected devices. Each individual signaling circuit shall be classified as a circuit pair.
- C. All cabling in racks, cabinets and junction boxes shall be neatly strapped, dressed and adequately supported. Cable installation shall conform to good engineering practices and to the standards of the National Electrical Code.
- D. Cables shall be terminated with the proper connector required for the associated operation of the equipment to which it is connected. Screw terminal blocks shall be furnished for all cables, which interface with racks, cabinets, consoles or equipment modules.
- E. All cables within a rack, console or junction box shall be grouped according to the signals being carried to reduce signal contamination.
- F. Where shielded conductors enter a panel or enclosure, and where power wiring exists, provision shall be made to provide physical isolation of signal and power conductors.
- G. Supply and install all fittings and accessories whether or not they are specified, required for proper, safe and reliable operation of the system.
- H. 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%.
- I. Minimum conduit size shall be 3/4" EMT with insulated bushings. Install conduit per engineered shop drawings. All conduit terminations in all boxes shall have insulated bushings.
- J. 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 view and or subject to damage.
- K. 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.

- L. All junction boxes containing fire alarm wiring are to be painted red and labeled.
- M. All plenum wiring is to be installed parallel and perpendicular to the building structure. Cable shall be bundled with plenum rated cable zip ties on a maximum of 2'-6". Install cable in D-ring hangers, secured to the structure at a maximum of 5' on center. Cable shall not lie on ceiling grid or ceiling tiles, light fixtures, piping, ductwork, or foreign equipment.
- N. The system ground is to be connected to the local ground bus. Under no conditions shall the AC neutral either in a power panel or in receptacle outlets be used for a reference ground.
- O. All wiring shall be in accordance with NFPA 72, the National Electrical Code, and Local Codes. All wiring sizes shall conform to recommendations of the equipment manufacturer, and as indicated on the engineered shop drawings.
- P. All wire shall be UL 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 UL Listed for such applications and is of the low smoke producing fluorocarbon type and complies with NEC Article 760 and approved by the local authority having jurisdiction.
- Q. No other wiring shall be run in the same conduit as fire alarm wiring.

3.3 FINISHES

- A. Main Fire Alarm Panel color shall be approved by Owner / Architect.

3.4 ALARM SYSTEM SEQUENCE OF OPERATION

- A. General:
 - 1. All fire alarm circuits shall be electrically supervised.
 - 2. Automatic response functions shall be accomplished by the first device initiated. Alarm functions resulting from initiation by the first device shall not be altered by subsequent alarms. An alarm signal shall be the highest priority. A pre-alarm signal shall have second priority and supervisory or trouble signals shall have third and fourth level priority. Signals of a higher level priority shall take precedence over signals of lower priority even though the lower priority condition occurred first.
- B. Fire alarm operating sequences shall be as follows:
 - 1. Activation of any automatic detector, manual station, fire suppression system, sprinkler flow switch or any other system required by NFPA 72 to be monitored to initiate an alarm condition shall cause the location of the alarm to be identified in an audible and visual manner at the building fire alarm control panel (FACP), and shall initiate the following events:
 - a. The system common alarm LED on the CPU Module shall flash. The internal audible trouble device shall sound. Acknowledging the alarm condition shall silence the audible trouble device and revert the flashing common alarm LED to a steady state.
 - b. The alphanumeric display shall indicate all applicable information associated with the alarm condition including: zone, device type, device location, and time of alarm. Location and zoning messages shall be custom field programmed to respective premises.
 - c. Any remote or local annunciator LED's associated with the alarm point shall be illuminated as herein specified.

- d. The remote signaling connection shall be activated relaying the alarm signal to an approved central station (central station connection and service provided by Owner). Point ID and descriptor must be sent and received.
 - e. All automatic events programmed to the alarm point shall be executed and the associated indicating devices and/or outputs activated.
 - f. Activate all audible/visual alarm devices. Where prerecorded voice announcement is required or specified, the prerecorded announcement shall be preceded with attention tone(s), followed by the approved prerecorded announcement and continue in a cycle until the system is reset. Manual voice announcement shall interrupt the prerecorded cycle and the prerecorded cycle shall resume automatically after three minutes.
 - g. De-activate all HVAC systems including low speed high volume (LSHV) circulating blade type fans.
 - h. De-energize the kitchen hood supply/exhaust fans as required by local authority having jurisdiction.
 - i. Close all related smoke dampers.
 - j. Close all related smoke/fire dampers.
 - k. Release all magnetic door hold open devices.
 - l. Release the electric strike, unlocking, but not unlatching, locked doors controlled by an access control system.
 - m. Release Counter Shutters and hold-open devices on all fire and smoke doors.
 - n. Open all security grilles with emergency egress.
 - o. Activate to close all related fire and smoke doors and shutters.
 - p. Activate signaling connection to the elevator as required by the local authority having jurisdiction.
 - q. Signal the building automation system and Owner's security/police personnel as directed by Owner/Architect. The audible alarms shall be inhibited from being silenced for a period of 3 minutes after commencing operation unless alarm is acknowledged and appropriate action has been taken.
 - r. Activate automatic recall operation of elevators as required by local authority having jurisdiction.
 - s. Record all events on the system printer.
2. Activation of duct mounted smoke detector on the HVAC equipment, or a smoke detector mounted in the return/supply air stream of any fan shall shut down all units as required by NFPA. The activation of one of these detectors shall send an alarm signal to the control panel and also initiate the Alarm Sequence of Operation.
 3. Activation of a control valve supervisory switch shall initiate the following events:
 - a. The activation of any sprinkler valve supervisory (tamper) switch shall activate the system supervisory service audible signal and illuminate the LED at the building fire alarm control panel (FACP). Differentiation between valve tamper activation and opens and/or grounds on the initiation circuit wiring shall be provided.
 - b. Activation of a sprinkler system control valve supervisory switch shall not prevent the events listed under Article 3.4.
 - c. Restoring the valve to the normal position shall cause the supervisory service audible signal to pulse, indicating the restoration to normal position. The supervisory service reset key shall be provided to silence the audible signal.
 4. Activation of the smoke detector and heat detector in the elevator machine room and at top of elevator shaft shall cause the elevators' controllers to be tripped by way of the shut trip breaker, and shall also initiate the events listed under Article

- 3.4.
5. Any subsequent fire alarm shall reactivate the alarm indicating appliances and activate the respective control sequences described above.
 6. Upon reset of the fire alarm control panel, HVAC units shall be capable of being started, and resume normal operation.
 7. When the fire alarm panel is in alarm, the fire alarm panel shall signal the digital lighting control system, as required, to activate and turn all lights to full bright in all NFPA 101 paths of egress and as required by the Fire Marshall. Once the fire alarm (or drill) is cleared, the fire alarm panel shall signal the digital lighting control system as required to enable the digital lighting control system to revert to normal operation with the lights to remain illuminated until manually turned off using the digital lighting control system.
- C. Activation of the manual evacuation (drill) switch shall operate the alarm indicating appliances without causing other control circuits to be activated. However, should true alarm occur, all alarm functions should occur as described.
- D. ALARM VERIFICATION shall be field programmed for each respective detector. Global verification will not be acceptable. The verification sequence is activated after a "check" procedure and the panel will wait a field programmable delay period (0-50 seconds) then proceed to re-sample the detector for continued presence of smoke. If the alarm condition still exists or a non-verified device is actuated during the verification period, the system will then initiate all alarm sequences specified herein. The system shall incorporate the ability to log in memory the number of verification events that have occurred for each selected device.

3.5 EQUIPMENT IDENTIFICATION

- A. Each panel or equipment enclosure shall be provided with a permanently engraved or embossed or silkscreen identification tag. The tag shall include the following information:
1. Name of manufacturer.
 2. Manufacturer's equipment description.
 3. Serial number and model number.
 4. Voltage and current rating.
- B. All addressable devices shall be labeled with point and module number. Provide label maker style label on base of device. Verify exact requirements with Owner.

3.6 SPARE PARTS AND TOOLS

- A. Interchangeable Parts: All spare parts furnished shall be directly interchangeable with the corresponding components of the installed system. Spare parts shall be packaged and identified by nameplate, tagging, or stamping. Spare parts shall be delivered to the site in unopened cartons for storage as directed by the Owner.
- B. Spare Parts: Provide minimum of two, or 5% of building total, whichever is greater unless noted otherwise.
1. Spare shut down modules
 2. Spare detectors of each type in the system
 3. Spare alarm indicating devices of each type in the system
 4. Spare manual pull stations
 5. Spare protective covers of each type in the system.
 6. Spare relays/controls required for connection to smoke and fire/smoke dampers
 7. Devices listed above are to be installed as directed by Architect/Engineer or local code authorities at no additional cost to the Owner. Unused spare parts are to be parts for Owner's cabinet.

- C. Provide one smoke, heat and carbon monoxide detector testing kit. SDfire #TF2823 with Solo Testfire #2001 tester with 15-foot access pole and three 4-foot pole extensions, detector removal tool, and carrying bag.
- D. Provide two copies of the final software programmed into the fire alarm system.
- E. Parts list: Furnish a list, in duplicate, of all other parts and accessories the manufacturer of the system recommends to be stocked for maintenance.

3.7 KEYS

- A. Keys and locks for all equipment shall be identical. Provide not less than six keys of each type required. Identify keys by an appropriate number stamped on each key or on a metal tag attached thereto. Provide a key numbering chart in each operation and maintenance manual furnished.

3.8 SMOKE DAMPERS AND FIRE/SMOKE DAMPERS

- A. Smoke dampers and combination fire/smoke dampers shall be controlled by an automatic alarm initiating device. Smoke dampers installed to isolate the air handling system shall be arranged to close automatically when the system is in alarm.
- B. Coordinate motor operator voltage with supplier.
- C. Open all dampers prior to starting air handling equipment.
- D. Provide 120V power from nearest general purpose 20A receptacle circuit as required, or as noted otherwise.

3.9 GRAPHIC FLOOR PLANS

- A. Provide two (2) color coded floor plan detailed with project name, actual room names, actual graphic room numbers as directed by the Owner and adequate information to direct people to the fire alarm devices in alarm and to exits with non-fading floor plan media. Do not use architectural plan room names and numbers.
- B. Each plan shall clearly relate the room numbers on the annunciator to the area description on the floor plan. All fire alarm devices located to correspond with the annunciator. Indicate location of all end-of-line resistors.
- C. Provide graphic floor plans with all fire alarm devices and equipment, with labels and addresses matching system programming and reporting. The floor plan shall be provided in lexan protective covering and framed.
 - 1. Minimum size 30x42 inches, mounted adjacent to FACP in MDF and at remote annunciator.
 - 2. Provide digital copy of graphic floor plan in AutoCAD (.dwg) format.
- D. Provide and mount framed signed FML certificate adjacent to FACP.

3.10 OPERATING INSTRUCTIONS

- A. Coordinate with Owner for appropriate off-site monitoring service and communication technology to be used. Provide all necessary programming for interfacing with the Owner's on-site and off-site remote signaling receiving station, including programming of

descriptors and addresses at the receiving station.

- B. Provide Fire Alarm System Operating Instructions for the following items including, but not limited to:
 - 1. Alarm Signal
 - a. How to open panel door
 - b. What to read and follow the instruction on display
 - c. How to acknowledge alarm
 - d. How to silence the signals
 - e. How and when to reset the system
 - f. How to return system to normal operation
 - 2. Trouble / Supervisory
 - a. How to open panel door.
 - b. What to read and follow the instruction on display
 - c. How to acknowledge trouble condition
 - d. Appropriate personnel to respond
- C. Provide laminated instructions in extruded aluminum frame. Mount adjacent to the Fire Alarm Control Panel and remote annunciator panel(s) for ready reference.

3.11 ADDITIONAL REQUIREMENTS

- A. For campuses with existing fire alarm systems, the existing fire alarm system shall remain fully functional and monitored until the new system is fully installed, inspected, and accepted by the AHJ and owner.
- B. The contractor is to ensure all areas of the building are covered with visual and audio alarm devices for occupant notification of a fire alarm, including remote portable or temporary buildings.
- C. Coordinate door hold devices with door and door hardware.
- D. Provide interface with and coordinate shunt-trip circuit breakers and control devices with kitchen hood fire control systems and elevator equipment.
- E. Alarm circuit power supplies and circuiting shall be designed and installed to accept an additional five (5) 110cd visual devices for future expansion. The initial design shall not exceed 70% of the rated power supply and circuit capability.
- F. Install system event printer as directed by Owner/Architect.
- G. Provide programming or re-programming of all hot keys as directed by Owner including, but not limited to, fire drill, AHU shutdown bypass, horn/strobe disable, elevator test.
- H. Provide one dedicated alarm circuit for (future) portable (temporary) building(s) to the nearest main building egress exit discharge to the designated portable building location. Provide 100 feet of cable coiled and marked "FACP-ALARM-PORTABLES" above an accessible ceiling.
- I. Provide one dedicated addressable initiating device circuit with a minimum capacity of 50 devices for (future) portable (temporary) building(s) to the nearest main building egress discharge to the designated portable building location. Provide 100 feet of cable coiled and marked "FACP-INITIATING PORTABLES" above an accessible ceiling.
- J. Provide printer and printer stand at main FACP; exact location as directed by Owner / Architect.

- K. Provide control module relays to interface with the digital lighting control system; refer to specification Section 26 09 28 Digital Lighting Control System. Provide Form C dry contacts to indicate 1) Fire alarm (including fire drill activation) and 2) Fire Alarm cleared.
- L. Provide 40 initiating devices and two audible circuits for portable buildings. These shall be used to service existing portable buildings and remainder shall be left as spare above accessible ceiling.

3.12 COMMISSIONING THE SYSTEM

- A. The installing contractor shall be responsible for verifying that each component of the system is fully operational and in conformity with the specifications. He shall also be responsible for insuring that all elements function together as a system in accordance with the specifications.
- B. A state licensed NICET II minimum and factory trained technical representative of the manufacturer shall supervise the final control panel connections and testing of the system. Upon completion of the acceptance tests, the owner and/or his representatives shall be instructed in the proper operation of the system.
- C. The installing contractor shall functionally test each and every device in the entire system for proper operation and response. Field testing shall include voice intelligibility as required by the latest edition of NFPA 72 Any items found not properly installed or non-functioning shall be replaced or repaired and retested. The final test indicating a fully functional fire alarm system shall be recorded and an electronic Excel and printed copy submitted to the Architect, Engineer and Owner.
- D. The installing contractor shall provide a complete written report in electronic form and printout of the functional test and intelligibility test of the entire system. A copy of the test report shall be provided with the Maintenance and Operation Manuals. The test report shall be signed and dated by the licensed fire alarm superintendent responsible for supervising the final system test and checkout. This test shall be witnessed and accepted by the Owner prior to testing for the local Fire Marshall.
- E. The installing contractor's fire alarm superintendent 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. The Contractor shall affix his certification label and installation certificate to the interior of the main fire alarm control panel.
- F. The testing and acceptance shall be performed within 30 days after the fire alarm installation is completed. The test shall be performed by a minimum of two qualified fire alarm system technicians acceptable to the authority having jurisdiction. The test which is a comprehensive 100 percent inspection and test of all fire alarm system equipment shall include the following:
 - 1. Fire alarm control equipment: a visual and functional test of the fire alarm control and auxiliary control equipment.
 - 2. A visual inspection shall be conducted to establish that all electrical connections and equipment, as required, are properly installed and operating.
 - 3. A functional fault simulation test shall be conducted on all relevant field wiring terminations to ensure that wiring is properly supervised as required.
 - 4. Indicators shall be tested to ensure proper function and operation.
 - 5. Control panel auxiliary functions shall be functionally tested to verify proper operation.
 - 6. Control panel supervisory and alarm current readings shall be taken to verify that the control panel has the appropriate power supplies and standby batteries to

- operate the system as required. A three-minute general alarm stress test, both under AC power and standby power, shall be conducted to further ensure complete operation of the system.
7. Fire alarm peripheral devices; All fire alarm peripheral devices shall be functionally tested and the location and testing information recorded for each device.
 8. Manual initiating devices:
 - a. Each manual fire alarm station shall be functionally tested for alarm operation.
 - b. Each manual fire alarm station shall be functionally tested for proper wiring supervision.
 9. Automatic initiating devices:
 - a. Each automatic initiating device shall be activated in accordance with manufacturer's instructions to ensure proper operation.
 - b. Each automatic initiating device shall be functionally tested for proper wiring supervision.
 - c. Each automatic initiating device shall be inspected to ensure proper placement and mounting as required by specifications.
 10. Alarm signaling devices:
 - a. Each alarm signaling device shall be tested and decibel reading taken at 10' from the device and recorded to ensure proper operation. Each area's voice alarm signaling devices shall be tested for intelligibility.
 - b. Each alarm signaling device shall be functionally tested for proper wiring supervision.
 - c. Decibel reading shall be taken to ensure that the alarm signal level can be clearly heard in all areas of the facility.
 - d. All visual alarm indicators shall be functionally tested to ensure proper operation and that they are clearly visible.
 11. Elevators: Each elevator shall be tested and automatic recall function verified.
 12. Reporting: Upon completion of the initial verification audit, a report shall be sent to the Architect/Engineer indicating that all fire alarm equipment has been tested and is in 100 percent operation. The report shall also contain the audit testing information as to the location and operational status of each peripheral device. The 100 percent audit shall be performed by a factory-trained representative. The report shall include the voice intelligibility performance in each area and indicate compliance with NFPA and local AHJ requirements.
- G. It is the intent of these specifications and of the Architect/Engineer that a continued program of system maintenance is to be provided by the Owner in compliance with NFPA 72. It is mandatory that the installing Contractor provide such services and make available these services to the Owner upon completion of the project.
- H. Upon completion of installation and full acceptance testing, submit NFPA 72 certificate of compliance that the total fire alarm system, including any subsystems, is fully functional and that the components are UL listed for function intended.

3.13 SUBSTANTIAL COMPLETION

- A. Final acceptance of the FIRE ALARM SYSTEM by the owner, local code authorities and Occupancy Permit has been issued.
- B. All fire alarm system shop drawings, test reports, operating and maintenance manuals, maps and as-built drawings shall be submitted in electronic format to and accepted by the Architect / Owner prior to date of substantial completion.
- C. Acceptance by County or Local Fire Marshall.

3.14 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 substantial completion. Major components including but not limited to the main fire alarm panel, sub-panels, panel extenders, power supplies and emote annunciators. Any equipment or workmanship shown to be defective shall be repaired, replaced or adjusted during normal working hours at no cost to the owner within 4-hour notification. Any equipment replaced shall be complete with full factory warranty for that part beginning on the date of installation.
- B. Repair services and replacement parts for the system to be furnished under this Contract shall be available for a period of ten years after the date of final acceptance. Service during the warranty period shall be provided within four hours after notification and all repairs shall be corrected within 24 hours after notification throughout the warranty specified in this section.
- C. The installing contractor shall provide 24 hour, 365 days per year emergency service with factory trained, state licensed service technicians.
- D. 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.
- E. Provide a certified fire alarm test of the complete system no earlier than 30 days prior to the end of the warranty period and correct any and all items to bring the system to an approved status at no cost to the Owner. Clean all smoke detectors and replace all defective parts at no cost to the Owner.
- F. Guarantee labor, materials, and equipment provided under this contract against all defects for a period of one year after the date of final acceptance and receipt and approval of "As-Built" drawings and schematics of all equipment.
- G. All manufacturer's warranties which extend past final completion shall be fully transferred to the Owner.

3.15 TRAINING

- A. Provide training course to all fire personnel assigned by Owner's Representative. The training shall include a course syllabus and hands-on participation. Training shall be conducted on a system identical to the one being installed on this project. The system shall be able to perform all system operations and simulate all types or forms of alarm conditions.
- B. Provide a video of the training program to the Owner's Representative to be used for periodic refresher course, training of the local fire department and for training of new employees.
- C. The training course shall include, in addition to the above, a system overview, and a review of the operation and maintenance manual.
- D. The instructor shall be factory trained and shall be thoroughly familiar with all parts of the installation on which instruction is to be given. The instructor shall be trained in operating theory as well as in practical operation and maintenance work.

END OF SECTION

**SECTION 28 55 00 -
RF SURVEY FOR IN-BUILDING EMERGENCY RESPONDER RADIO COVERAGE (ERRC)
AND
TESTING OF EXISTING ERRC ENHANCEMENT SYSTEMS (EERCES)**

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. The purpose of this specification is to establish the requirements and standards for surveys for public safety radio signal strength in buildings as required by the NFPA, IBC, IFC and local AHJ. This specification is only for a RF survey. If an existing ERRCES is on premise and is operational, provide verification and documentation of the existing ERRCES as specified.
1. This survey is required as part of the contract documents and shall be implemented as specified in this specification unless indicated or specified otherwise.
 2. This survey is required for in all buildings with basements, all buildings four stories and taller, and all buildings with an aggregate total building area of 50,000 square feet or more; this survey may still be required for other buildings that do not meet these structural requirements.
 3. This survey may not be required if the local AHJ has pre-determined that an Emergency Responder Radio Coverage Enhancement System (ERRCES) is not required for the subject building(s). If a survey is not required by the AHJ, notify the Architect, Engineer, Owner prior to scheduling the survey.
 4. The survey requirements specified in this section are intended to be slightly more stringent than minimum IBC and IFC requirements. This is to help mitigate radio coverage deficiencies that could be caused by future minor variations in building use configurations and changing atmospheric conditions.
- B. Where the subject building(s) do not have an existing ERRCES, this survey shall be for ERRC measurements and compliance evaluation only, it is not intended as a requirement for designing nor a requirement for providing an ERRCES.
- C. Where the subject building(s) have an existing and operational ERRCES, this survey shall include a full yearly functionality test of the existing ERRCES hardware, antennae, wave guides, cabling, wiring, and connectivity as required by the local AHJ, IBC, IFC, and NFPA. This survey shall then be able to be used for the required yearly inspection and testing report of the existing ERRCES. If deficiencies of an existing ERRCES are observed or detected during field signal measurement, the contractor shall document those deficiencies and report them to the Owner in writing within two Owner's business days of completion of the testing so that the Owner can take immediate remedial action. Corrections and modifications to existing ERRCES are not part of this specification section requirements.
- D. Technical information for this survey shall be obtained from the local AHJs pertaining the specific technical information and requirements for the emergency responder communications coverage system. This information shall include but not be limited to the various frequencies required, the location of radio antennae sites, the effective radiated power of the AHJ radio antennae sites, the maximum propagation delay in microseconds, the applications being used, and other supporting technical information that would be necessary for an ERRCES design and to fully test an existing ERRCES.

- E. Surveys for new construction shall be performed after the building is fully dried in, with interior wall construction and all exterior wall glazing completed, and prior to start of installation of electrical wiring. It is the intent that this survey be completed as soon as practical, results reported to the Owner and analyzed, and if required or specified as part of the contract documents or if it is to be provided by others, a radio antenna/repeater system can be designed, installed, fully operational, and commissioned without delaying the scheduled contract date for certificate of occupancy (CO) or the AHJs final inspection and approval for full Owner and public occupation of the building.
- F. Conduct surveys using a RF Spectrum Analyzer, a calibrated system-compatible radio or another suitable instrument with traceable certificate of calibration to analyze the RF signal strength of Emergency Responder Radio Signal into the building and determine if amplification of the signal is required or that if existing, the existing ERRCES is functioning properly and providing the proper radio coverage. All test equipment shall have been calibrated within the previous 12-months of the date(s) of testing. Both inbound and outbound signal strength shall be determined, measured, calculated, and documented as required by code. General weather conditions and time of day during the test shall be documented as part of the survey report.

1.2 SURVEY CRITERIA

- A. The required Public Safety Radio Signal Level inside the Owner's facility shall be as required by code, ordinance, AHJ, and as specified.
- B. Survey shall be performed by an FCC licensed technician holding a current General Radiotelephone Operator License (GROL). Where required by the local AHJ, the licensed operator shall be registered with the AHJ as an ERRC Special Inspector (or equivalent designation given by the AHJ) with in-building emergency radio system certification issued by a nationally recognized organization, school, or the emergency radio system manufacturer of the equipment being tested where an existing ERRCES is being tested, or certification by the ERRCES if a new ERRCES is specified elsewhere to be installed as part of the contract documents.

1.3 REGULATIONS

- A. Codes, regulations, and standards shall be the latest published standards. The latest national published standards listed below shall supersede any local standard unless doing so would violate the intent of the local code requirements.
 - 1. NFPA 1 – Fire Code
 - 2. NFPA 70 – National Electrical Code
 - 3. IFC 510- Emergency Responder Radio Coverage
 - 4. NFPA 101, Life Safety Code, and all local amendments and requirements.
 - 5. NFPA 72 National Fire Alarm and Signaling Code
 - 6. FCC 47 CFR Telecommunications
 - 7. FCC 47 CFR 90.219 Use of Signal Boosters
 - 8. IFC - International Fire Code
 - 9. Local or State Fire Codes
 - 10. ADA "Americans with Disabilities Act" and any local or state or local accessibility standards and amendments.
 - 11. FCC's OET 65 Standards "Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields"
 - 12. FCC Rules Part 22 Public Mobile Services, Part 90 and Part 101
 - 13. NFPA 1221- Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems

RF SURVEY FOR IN-BUILDING EMERGENCY RESPONDER RADIO COVERAGE (ERRC)
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14. IBC - International Building Code
15. UL 2524 - Standard for In-building 2-Way Emergency Radio Communication Enhancement Systems
16. NFPA 3000 (PS) - Standard for an Active Shooter/Hostile Event Response (ASHER) Program and if present, Owner's specific ASHER Program. Note: Although currently considered by the NFPA as a Provisional Standard (PS), the issued NFPA 3000 shall be considered part of this specifications as if it were a fully accredited document to NFPA standards. If the building Owner has established an ASHER Program, it too shall be considered part of this specification section requirements.

1.4 DEFINITIONS

A. Definitions:

1. Area: A enclosed space in a building consisting floor to ceiling walls with doors.
2. ASHER Program: Active Shooter Hostile Event Response Program. Program elements developed by the building's Owner to determine the necessary functions and actions related to preparedness, response, and recovery from an active shooter/hostile event response.
3. BDA: Bi-Directional Amplifier. A device used to amplify band-selective or multi-band RF signals in the uplink, to the base station and in the downlink from the base station to subscriber devices for enhanced signals and improved coverage.
4. BER: Bit Error Rate is the number of bit errors per unit time
5. DAS: Distributed Antenna System
6. ERRCES / ERRCS: Emergency Responder Radio Coverage Enhancement System / Emergency Responder Radio Coverage System. A two-way radio communication system installed to assure the effective operation of radio communications systems for fire, emergency medical services, or law enforcement agencies within a building or structure. A system used by firefighters, police, and other emergency services personnel.
7. FCC: Federal Communications Commission
8. Grid or test grid: The individual specified and/or code required imaginary spaces inside the building used for radio coverage testing. Typically a grid space consist of a square space with equal or almost equal side dimensions where the radio signal levels are measured at the center of each grid space to verify radio coverage. Grid spaces can consist of individual areas or rooms meeting the maximum size requirements.
9. GROL- FCC General Radiotelephone Operators License
10. OET 65 Standards: FCC's Bulletin 65 provides Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields.
11. Public Safety/First Responder: Public Safety or First Responder agencies that are charged with the responsibility of responding to emergency situations. These include, but are not limited to law enforcement departments, fire departments, and emergency medical companies. Typically, there may be multiple agencies for each type of responder, including those administered by the building Owner.
12. RSSI: Received signal strength indicator RSSI is a relative measurement of the power present in a received radio signal.
13. Zone: The individual partitioned grid specified and/or code required imaginary space(s) inside large buildings. Typically, each zone shall be no more than 50,000 square feet and shall be contiguous on the same building floor. Zones are further sub-divided into smaller grid spaces so that radio signal levels can be measured at the center of each grid space to verify radio coverage. A zone can be an individual wing of a building or separate floors of a building that do not exceed 50,000 square feet each. Zones can be created for separate test report

areas to ensure individual grid test spaces are not excessive in physical area size and detrimental to the accuracy and resolution of the test data measurement point locations. Each zone must pass the radio coverage test for the entire building to pass the test. Zones can exceed 50,000 square feet as long as the maximum allowable grid space size is not exceeded.

PART 3 – EXECUTION

3.1 EXECUTION

- A. Testing Procedures and Parameters
1. The test shall be conducted using a calibrated portable radio authorized by the local AHJ, and of the latest brand and model used by the agency talking through the agency's radio communication system.
 2. Testing shall include all critical areas required by the NFPA 1221 and others included in the list below. Critical areas shall be provided with a minimum 99-percent floor area radio coverage in each specific area. Critical areas include but are not limited to the following areas:
 - a. Fire command centers
 - b. Fire pump rooms
 - c. Exit stairs
 - d. Exit passageways
 - e. Elevator lobbies
 - f. Areas of rescue or refuge
 - g. Areas with or spaces adjacent to standpipe cabinets
 - h. Areas with or spaces adjacent to sprinkler sectional valve locations
 - i. Areas with or spaces adjacent to bleeding control kits.
 - j. Areas with or spaces adjacent to Automatic External Defibrillators (AEDs) for public use.
 - k. Areas designated for persons with special needs or areas for specifically designated for persons who are not ambulatory including those in wheelchairs but require physical assistance by others to evacuate the building.
 - l. Specific bullet resistant areas or spaces designated by the Owner or designated in the Owner's ASHER Program as a bullet resistant panic and safe room/areas or spaces.
 - m. Front lobby areas and/or building administrative areas with direct wired microphone or wired telephone handset access to the building's mass notification or building wide communication system when such system is existing or to be installed as part of this project.
 - n. Areas and/or building administrative areas with public safety radio base stations used for direct communications with Owner's police or security personnel.
 - o. Other areas deemed critical by the AHJ.
 3. Testing grid spaces, areas, and zones shall be as required by the local AHJ and/or as specified in this specification. The more stringent requirements of the local code, AHJ, or those specified or indicated elsewhere in the contract documents shall apply. Specific requirement for the test grids, areas, and zones shall be follows:
 - a. Testing shall be based on a minimum of 20 approximately equal size grid spaces per floor or zone with a maximum of 2,500 square foot per test space. Failure of more than one test space shall be considered a test failure.

- b. In the event that only two test spaces fail the 20-space grid test above, the same floor/zone shall be divided into 40 approximately equal size grid spaces or a maximum of 1,250 square feet per space and re-tested. Failure of only one or only two nonadjacent test spaces on that floor or zone shall result in a non-failure for that floor or zone. Failure of three or more spaces shall result in a test failure for that floor or zone. Failure of two adjacent test spaces shall result in a test failure of that floor or zone.
4. If there is an existing ERRCES and there are grid space test failures resulting in a failed test, notify the Owner in writing immediately about the failed spaces after the completed test and identify the specific areas of the building that are not compliant. The final test result formal submittal data may be submitted at a later date as specified. Contractor may provide recommendations for alterations or modifications to the existing system to the Owner/Architect/Engineer so that the deficiencies can be addressed by the Owner as soon as possible and corrective measures taken by the Owner. Make corrective measures or modifications to the existing system only if specifically instructed by the Owner in writing.
5. Two-way radio communications shall be verified by testing the two-way communication to and from the outside of the building from a single point approximately at the center of each test grid space or room area. Retesting from a different point inside the same grid space or room area is prohibited if the first point selected fails the test. The initial failure shall be recorded as a failed test grid space or area.
6. Signal strength for a non-failure shall be sufficient to meet the requirements of the applications being utilized by public safety for emergency operations through the coverage area as required by the AHJ.
7. The minimum inbound signal strength shall be sufficient to provide usable voice communications throughout the coverage area as required by the AHJ. The inbound signal level shall be sufficient to provide not less than -95 dBm for analog systems or a Delivered Audio Quality (DAQ) of 3.0 for digital systems or an equivalent Signal-to-Interference-Plus-Noise-Ratio (SINR) applicable to the technology of either analog or digital signals.
- 8.. The minimum outbound signal strength shall be sufficient to provide usable voice communications throughout the coverage area as required by the AHJ. The outbound signal level shall be sufficient to provide not less than -95 dBm for analog systems or a Delivered Audio Quality (DAQ) of 3.0 for digital systems or an equivalent Signal-to-Interference-Plus-Noise-Ratio (SINR) applicable to the technology of either analog or digital signals.
9. Buildings with existing ERRCES: Verify the following, include the requested information report deficiencies to the Owner as part of the ERRC report.
 - a. Verify the existing ERRCES is fully monitored by the building fire alarm system as required by NFPA 1221 and NFPA 72.
 - b. If there is an existing remote ERRCES annunciator, verify all annunciators and indicators required by NFPA 1221 are operational and functioning properly.
 - c. The gain values of all existing ERRCES amplifiers shall be measured and documented for comparison for future annual testing of the ERRCES.
 - d. A spectrum analyzer or other suitable test equipment shall be used to verify spurious oscillations are not being generated by existing signal booster(s).
 - e. Verify that the isolation between the donor antenna and all inside antennas is maintained to a minimum of 20dB above system gain.

3.2 SURVEY REPORT SUBMITTALS

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- A. Submit summary findings and detailed test report data within 14-days of notice to proceed.
- B. Buildings not in compliance with the ERRC testing: Indicate areas of the building deficient in ERRC. Provide general recommendations of the necessary equipment and means required to bring the building into full ERRC compliance for Owner review in the summary findings. This specification section is only intended for survey, report, and recommendation information only and is not intended for detailed design, modification, or corrective measures. The report data submittal shall be complete in such that it would be useful to assist in a detailed design of a ERRCES. Submit additional report data as indicated below.
- C. Building in compliance with required ERRC: Include a copy of the inspection report to be issued to the AHJ(s) in the format required by the AHJ(s) and submit the report to the AHJ(s) as part of the building permitting process.
- D. Report data submittals shall include but are not be limited the following:
 - 1. Include a copy of survey contractor's AHJ and FCC required licenses to perform the survey.
 - 2. Where there is an existing ERRCES, include an updated ERRCES technical document and yearly report which the Owner shall keep on file as required by NFPA 1221. Technical documents shall in include but may not be limited to the following information typically provided by the AHJ(s):
 - a. Frequencies required by the AHJ(s) for the existing in-building enhancement system (EERCES).
 - b. Location and effective radiated power (ERP) of radio sites used by the public safety radio enhancement system (ERRCES).
 - c. Maximum propagation delay in microseconds.
 - d. List of specifically approved ERRCES components.
 - e. Other supporting technical information necessary for the existing system maintenance, or future modifications.
 - 3. Confirmation that the ERRC for the building that is subject of the report has been determined to meet the minimum coverage requirement as defined by the IBC/IFC, this survey specification section's requirements, and the local AHJ requirements.
 - 4. Include a scaled drawing of the building with RF measurements of each floor or zone of the building which indicates relative RF field strength for each frequency band of interest. Minimum drawing size 11x17-inch, maximum 30x42-inch.
 - 5. The drawings shall indicate clearly the areas that have passed or failed based on the more restrictive of the above parameters or those specifically required by the AHJ.
 - 6. When required by the AHJ, inspection reports by AHJ approved third-party inspector in the format required by the AHJ.

END OF SECTION

SECTION 28 60 00 - DISTRICT RADIO COMMUNICATIONS EQUIPMENT

PART 1 - GENERAL

1.1 DESIGN AND CONSTRUCTION REQUIREMENTS

- A. Provide a complete and tested Radio Communications System, consisting of an Emergency Radio system and a Radio Repeater system.
- B. Contractor Requirements:
 - 1. Contractor shall provide five years of experience in the installation of radio frequency communications equipment and be a factory authorized dealer and installer for Kenwood equipment. Installation and programming shall be performed by FCC licensed technicians for this type of equipment. The following contractors have been pre-approved by CFISD; other contractors to provide documentation and certification prior to being awarded job.
 - a. Northwest Communications 281-890-4724 (Rick Wright, Don Cameron)
 - b. Texas Bigfoot Communications 713-462-2929 (Rick Cogar)
- C. Submittals (Required):
 - 1. Product Literature: Complete manufacturer's product literature showing electrical characteristics and connection requirements.
 - 2. Wiring Diagram: Indicate system wiring diagram showing each device and wiring connection. Indicate partition layout.
 - 3. Operation and Maintenance Data: Submit manufacturer's standard operating and maintenance instructions.

1.2 WARRANTY

- A. One year from date of substantial completion

PART 2 - PRODUCTS AND MATERIALS

- A. The Emergency Radio system shall include:
 - 1. UHF base station radio supporting the district wide emergency frequency.
 - 2. Mounting antenna in area to provide optimum performance for internal and external communications.
 - 3. Emergency radio and associated equipment shall be installed in mechanical area with the radio repeater.
 - 4. Accessory devices and power supply.
 - 5. Installation of equipment and cabling between antenna and emergency radio.
 - 6. Tone Remotes shall be installed in principal secretary's office and front reception.
 - 7. System setup, frequency programming and testing per CFISD Radio Communications Division requirements.
 - 8. Training shall include demonstration and instructing school staff on operation.
 - 9. Contractor responsible for cable and termination between IDA 24-66M VOIP Remote w/DeskMic and Network.
 - 10. Contractor is responsible for cable and termination between Emergency Radio and network.
 - 11. Equipment:
 - a. Radio: Kenwood NX-5800-K UHF, 45 watts, 450-520 MHz, 1024 channels/128 zones.
 - b. Mounting Case: Control Station mounting case for KPS-15 power supply and NX-5800-K radio
 - c. Power Supply: Kenwood KPS-15 power supply

- d. Telephone Style Remove Control: IDA 24-66M VOIP Remote w/DeskMic
 - e. Remote Termination Panel: IDA 20-28 VOIP Remote Adapter.
 - f. Antenna: Antenex Model FG4603, 3db gain UHF 460-470 MHz omni antenna with mounting bracket
- B. Radio Repeater (Repeater set-up required for ES, MS, HS, Transportation Centers, Stadiums & Multifunction Centers):
- 1. The Radio Repeater system shall include:
 - a. Radio repeater supporting the campus wide communication.
 - b. Mounting antenna in area to provide optimum performance for campus or facility communications.
 - c. Radio repeater and associated equipment to be installed in mechanical area.
 - d. System setup, frequency programming and testing per CFISD Radio Communications Division requirements.
 - e. Contractor responsible for cable and termination between network adapter and network.
 - f. Contractor is responsible for cable and termination between Kenwood KTI-3 network interface and network.
 - g. 4 post enclosed rack, duplexer, network adapter, and UPS.
 - 2. Equipment:
 - a. Repeater: Kenwood NXR-810K UHF, 1-40W, 450-520 MHz. Operational as analog 25 KHz or 12.5 KHz, or digital 12.5 KHz or true 6.25 KHz
 - b. FCC Licensing: Frequency coordination and acquisition for repeater
 - c. Antenna: CommScope DB404, 450-470 MHz 3.28/5dB gain
 - d. Duplexer: 633-6A-2N, UHF Duplexer 450-470 MHz
 - e. Network Adapter: Kenwood KTI-3 network interface
 - f. Rack: Tripp Lite SR25UB Smart Rack standard-depth half-height server rack enclosure, doors, and side panels
 - g. Power Supply: Minuteman ED2000RTXL2U power supply
 - h. Installation Materials: Connectors, lightning protection, mounting brackets, 5' antenna mast and all other required installation materials for a complete and operational set-up.
- C. Cabling:
- 1. Provide and install Times LMR-400-LLPL black low loss, plenum rated, indoor/outdoor coax antenna cable with connectors.
 - 2. Provide and install Cat 6 for 24-66M VOIP Remote w/DeskMic in principal secretary's office and front reception to network. Reference Division 27 10 00.
 - 3. Provide and install Cat 6 for IDA 20-28 VOIP Remote Adapter at the emergency radio to the network. Reference Division 27 10 00.
 - 4. Provide and install Cat 6 cable for Kenwood KTI-3 network interface at the radio repeater to the network. Reference Division 27 10 00.

PART 3 - EXECUTION

- A. Demonstration and Training:
- 1. A written test report from an authorized representative that the system has been 100% tested and is functioning properly shall be submitted prior to training and demonstration.
 - a. Contractor shall demonstrate system operation to DVISD security personnel and project manager.
 - b. Contractor shall provide one hour of instruction each for two of owner's personnel, to be conducted on site with the manufacturer's representative.

END OF SECTION

SECTION 31 00 00 - EARTHWORK

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Operations required for the excavation of materials on site.
 - 1. Operations required for the excavation of borrow material from approved sources.
 - 2. Compaction of natural subgrades.
 - 3. Placement and compaction of embankments to grade.
 - 4. Finish grading.
 - 5. Disposal of excess or unsuitable materials.
 - 6. Other required operations.
 - 7. Earthwork must conform with dimensions and typical sections shown, and within lines and grades established on the Drawings.
- B. The Contractor shall inform and satisfy himself as to character, quantity, and distribution of material to be excavated.

1.2 EXISTING UTILITIES

- A. The plans show the approximate location of all known underground utility lines and structures. Where pipes, ducts and other structures are encountered in the excavation but are not shown on the plans, immediately notify the Owner's Representative.

1.3 CLASSIFICATIONS

- A. Top Soil: Top 6 inches of natural surface soil possessing the characteristics of representative soils on the site that produce growths of grass or other vegetation. Topsoil includes grasses and other vegetation.
- B. Subgrade: Consists of that portion of the surface on which a compacted embankment or pavement is constructed.
- C. Compacted Embankment: Earth fill placed and compacted between subgrade and underside of pavement and fill areas adjacent to paving.
- D. Borrow: Material taken from approved sources to make up any deficit of excavated material. The borrow shall have a measured plasticity index of between 7 and 20 and shall be free of organic matter and excess silt.
- E. Finish Grading: Operations required for smoothing disturbed areas that are not overlaid with pavement.
- F. Stripping of Ground Surface: All vegetation, all decayed vegetable matter, rubbish, and other unsuitable material within the areas to be graded not removed by clearing shall be stripped or otherwise removed to ground level before grading or other earthwork is started. In no case will such material be allowed to remain in or on the areas to be graded.
- G. Excavation: After all necessary stripping has been done, excavation of every description and of whatever substances encountered within the grading limits of the project shall be performed to the lines and grades indicated on the Drawings.

- H. Compaction: Compaction of soil materials shall be measured as a percentage of Standard Proctor density as determined by the AASHTO Standard T 99 procedure.

PART 2 PRODUCTS

2.1 EQUIPMENT

- A. Furnish, operate, and maintain such equipment as is necessary to produce uniform layers, section, and smoothness of grade for compaction and drainage.
- B. Tamping Rollers:
 - 1. Use tamping rollers with one or more cylindrical drums. Each cylinder must be at least 48 inches long and 40 inches in diameter.
 - 2. The minimum weight per linear foot of drum length must be 1500 pounds weighted and 1000 pounds empty.
 - 3. For tamping rollers with multiple cylinders, each cylinder must rotate independently, and the cylinders must be pivoted on the main frame so that the units can adapt to irregularities in the ground surface.
 - 4. Provide approximately 2.7 tamping feet per square foot of drum surface on each cylinder. Stagger the feet uniformly over the cylinder surface. Each foot should have a face area between 5 and 7 square inches and a clear projection from the cylinder surface of 7 to 9 inches. Equip each unit with a device for cleaning the feet as the cylinders rotate.
 - 5. Use a crawler tractor with sufficient power to pull the tamping roller at a speed of approximately 3.0 miles per hour.
- C. Rubber Tire Rollers:
 - 1. Use rubber tire rollers having two axles and not less than a total of nine wheels with pneumatic tires.
 - 2. Mount the wheels so that the rear tires will not follow in the tracks of the forward tires and so the unit will give uniform compaction over the entire width of coverage.
 - 3. Mount the axles in a rigid frame with a loading platform or body suitable for being ballasted to a specified gross weight between 10 and 50 tons loading. The Owner's Representative will specify the tire inflation and gross weight.
 - 4. If the roller is not self propelled, the towing equipment must also have pneumatic tires.
- D. Use tank trucks, pressure distributors or other equipment designed to apply water uniformly and in controlled quantities to variable surface widths.
- E. Scarifiers, disks, spring tooth or spike tooth harrows, earth hauling equipment and other equipment must be suitable for construction of fills.

2.2 EARTH FILL

- A. Obtain embankment fill from required excavation or, if excavated material is not sufficient, from Borrow areas approved by the Owner's Representative.
- B. Use the best material available from excavation or borrow. Suitability of fill material is subject to the approval of the Owner's Representative.
- C. Fill material must be free of excessive silts. Do not use soil containing brush, roots, sod or similar perishable material.

- D. Embankment material must have a plasticity index between 7 and 20 inclusive.

PART 3 EXECUTION

3.1 REMOVAL OF TOPSOIL

- A. Remove topsoil within the limits of the construction areas as shown on the Drawings.
- B. Stockpile the topsoil for future distribution. Protect stockpiled topsoil from other excavated materials.

3.2 EXCAVATION

- A. As shown on the Drawings, excavate to lines, grades and elevations required for subsequent construction of embankments or pavement. Remove materials within the indicated limits and dispose of as directed.
- B. Maintain grades during excavation for complete drainage. When required, install temporary drains or drainage ditches to intercept or divert surface water and prevent interference or delay of the Work.
- C. If at time of excavation it is not possible to place material in the proper section of permanent construction, stockpile the material in approved areas for later use.
- D. Stones or rock fragments larger than 2 inches in their greatest dimension will not be permitted in top 6 inches of subgrade.
- E. Uniformly dress cut and fill slopes to slope, cross section, and alignment, as shown.

3.3 SUBGRADE UNDER PAVEMENTS

- A. After excavation is made to subgrade lines under proposed pavements, remove and replace soft or undesirable material with select material as specified for embankments. Stabilize and compact the subgrade as stated in the sections on stabilization of pavement subgrade.

3.4 TREATMENT OF NATURAL SUBGRADE UNDER EMBANKMENTS

- A. After excavation is made to lines under proposed embankments, remove soft or undesirable material to a depth determined by the Owner's Representative. Break down sides or holes or depressions to flatten the slopes.
- B. Fill each depression with the appropriate soil for the materials to be placed on the subgrade. Place the fill in layers moistened and compacted as specified in this section.
- C. After depressions have been filled and immediately before placement of compacted fill in a section of the embankment, thoroughly loosen the foundation material to a depth of 6 inches. Remove roots and debris turned up while loosening the soil.
- D. Compact the surface of the embankment subgrade as specified in the following paragraphs.
- E. Take care to prepare the embankment so that planes of seepage or weakness are not induced. Should the Owner's Representative suspect such a deficiency, the material must be thoroughly broken and recompacted before proceeding with construction.

3.5 PLACING EMBANKMENT FILL

- A. Do not place fill on any part of the embankment subgrade until the subgrade preparation has been inspected by the Owner's Representative.
- B. During the dumping and spreading process, remove all roots, stones and debris that are uncovered in the embankment material.
- C. After dumping, spread the material in horizontal layers over the entire fill area. The thickness of each layer before compaction must not exceed 8 inches unless otherwise directed. As soon as possible after placement begins, crown the surface to drain freely and maintain such conditions throughout construction.
- D. If the compacted surface of a layer is too smooth to bond with succeeding layers, loosen the surface by harrowing or other approved method before continuing the work.
- E. Stabilize and compact the top 6 inches of embankment fills under pavement sections as specified in the section on stabilization of pavement subgrade.

3.6 MOISTURE CONTROL

- A. Developing the maximum density obtainable with the natural moisture of the embankment material is preferred. However, the moisture content must be 1 to 3 percentage points wet of optimum, as determined by AASHTO Test Method T 99.
- B. If the moisture content is too high, adjust to within the specified limits by spreading the material and permitting it to dry. Assist the drying process by discing or harrowing if necessary. When the material is too dry, sprinkle each layer with water. Work the moisture into the soil by harrowing or other approved method.

3.7 COMPACTION

- A. Compact each layer of embankment with suitable rollers as necessary to secure at least 95% of the standard Proctor density, within the specified range of the moisture content, according to AASHTO Test Method T 99.

3.8 DISTRIBUTION OF TOPSOIL

- A. Preparation:
 - 1. Prior to placing topsoil, scarify the subgrade to a depth of 2 inches to provide effective bonding of the topsoil with the subgrade. Use a chisel plow with the chisels set 10 inches apart.
 - 2. Shape all areas designated for grading, including cut and fill areas, to receive a minimum of 6 inches of topsoil.
 - 3. In areas that require only blading and dressing, the adequacy of existing topsoil will be determined by the Owner's Representative.
- B. Placement:
 - 1. Do not haul or place wet topsoil. Also prohibited is placement of topsoil on a subgrade that is excessively wet, extremely dry, or in a condition otherwise detrimental to proper grading or proposed planting.

2. Distribute topsoil uniformly and spread evenly to an average thickness of 6 inches. Do no compact topsoil. Correct irregularities in the surface to prevent formation of depressions where water could stand.
 3. Perform the spreading operation so that planting can proceed with little additional tillage or soil preparation. Leave the area smooth and suitable for lawn planting.
- C. Where any portion of the surface becomes eroded or otherwise damaged, repair the affected area to establish the condition and grade prior to topsoil placement. Replace topsoil.

3.9 MATERIAL DISPOSAL

- A. Remove excess excavated material and excess topsoil from the area before substantial completion. Stockpile materials separately in designated areas. Excess soil, topsoil and strippings shall become property of the Contractor and shall be removed from the site.
- B. Dispose of waste material without causing expense or damage to the Owner.

END OF SECTION

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SECTION 31 00 01 - EARTHWORK UNDER BUILDING PAD

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. Protecting and preserving trees and vegetation to remain.
- B. Clearing, stripping, and grubbing of portions of sites which are below the building pads.
- C. Stockpiling stripped topsoil in approved locations.
- D. Excavating for and otherwise providing stable and compact subgrade below the building pads.
- E. Placing and compaction of select fill under improved areas to conform to elevations indicated on the drawings.
- F. Filling and finish grading of area around buildings and other improvements using imported topsoil per section 2.1,D.
- G. Coordinating Work of other Sections affecting or affected by Work of this Section.

1.3 INSPECTION OF SITE

- A. By making a proposal on the Project, the Contractor acknowledges:
 - 1. That the Owner and Architect do not guarantee the accuracy, completeness, or suitability of the contents of the Geotechnical Report or Topographic Survey.
 - 2. That he/she has visited the site to investigate the conditions affecting the Work and has satisfied himself/herself of the character, quality and quantity of surface and subsurface materials or obstacles to be encountered.
- B. The Contractor will be required to establish, maintain and be responsible for all reference points, hubs, grades, elevations, lines, and surface measurements. If any discrepancies in the documents are found, the Contractor shall promptly notify the Architect and await instructions before proceeding.

1.4 QUALITY ASSURANCE

- A. Inspection and Testing Laboratory Services: Test results shall meet or exceed the standards referenced.

1.5 REFERENCES

- A. ASTM International (ASTM)

1. D698, Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft³ (600 kN-m/m³) – Test for Moisture Unit Weight Relations of Soils and Soil Aggregate.
2. D2922, Tests for Density of Soil and Soil Aggregate in place by Nuclear Methods.

1.6 PRE-INSTALLATION CONFERENCE

- A. Refer to Section 01 31 13- Project Management and Coordination.

PART 2 - MATERIALS

2.1 MATERIALS

- A. Structural Fill: Sandy clay soils free of organic or other deleterious materials, and have a maximum clay lump size of less than three (3) inches. See Construction Documents for Liquid Limit and Plasticity Index per soils report.
- B. Earth Fill: Shall be excavated material approved by Architect prior to its use as earth fill around building and landscaped areas, but not under building.
- C. Stabilization Materials: Refer to stabilization section(s) in Division 31.
- D. Topsoil: Shall be imported, and shall be free from clay, vegetation, debris, stumps, roots, stones larger than 3/4 inch diameter, or other objectionable matter.

PART 3 - EXECUTION

3.1 GENERAL

- A. Unknown Utilities and Obstacles:
 1. If any unknown or uncharted utilities or objects are encountered during excavation, promptly notify the Architect before proceeding. Arrange with utility and telephone companies for removal and relocation of their equipment, and capping of pipes and wiring as required.
- B. Protection of Vegetation:
 1. Rope or fence off areas of the site that are designated to remain with vegetation to prevent vehicular traffic and construction damage.
 2. Provide wood barricades around trees and shrubs at their drip line in traffic areas to protect them from construction operations until Substantial Completion, or until barricade removal is directed by Architect.
 3. Replace damaged trees and vegetation designated to remain with vegetation of equal kind and size. Follow supplier's recommended procedures for planting necessary replacement vegetation.
- C. Clearing, Stripping and Grubbing (General):
 1. Remove brush, vegetation, debris, and surplus materials from the jobsite. Removal of other remaining impediments as may be necessary to properly execute the scope of this contract shall be included herein. Adhere to State and local code requirements for the disposal of trees and shrubs removed from the site.
 2. Do not remove trees or shrubs without the specific approval of the Architect. Vegetation damaged, removed, killed, or constricted from normal growth patterns

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shall be replaced with a comparable item, or the full replacement amount credited to the Owner.

- D. Drainage, Pumping and Grading:
1. Proper drainage of site shall be maintained during construction so that ponding of surface runoff does not occur and cause construction delays and/or inhibit access to the site.
 2. Contractor shall control the grading around building so that ground is pitched to prevent water from running into the excavated areas of building or damaging other structures.
 3. Provide pumping required to keep excavated spaces clear of water during construction.
 4. If any subgrade is damaged due to flooding, damaged area shall be removed and filled with select fill. Placement and compaction of select fill shall meet the requirements for placing and compacting select fill as specified below.
 5. If the subgrade, due to any reason or cause, lose the required stability, density, or finish before the foundation structure is placed, it shall be re-compacted and refinished at the sole expense of the Contractor.

3.2 BUILDING FOUNDATION (PAD) PREPARATION

- A. Site preparation area at buildings with and without adjacent sidewalks shall extend beyond the limits of the foundation area. See Construction Documents for Site Preparation limits.
- B. Existing fill material, top soil vegetation, roots, debris, organic material and other miscellaneous debris shall be removed to a depth of 9 inches and legally disposed of. Actual removal depth may vary and will be determined at time of construction.
- C. Over excavate the in-situ soils as required to allow the minimum amount of select structural fill to be placed beneath the slab to achieve the desired elevation. See Construction Documents for amount of select structural fill required per soils report.
- D. After stripping, and excavating to the desired grade as indicated above, the exposed soil shall be proof-rolled to locate all soft or loose areas. Soils, which are observed to rut or deflect excessively under the moving load, shall be undercut and replaced with properly compacted structural fill. The proof-rolling and undercutting activities shall be witnessed by a representative of the geotechnical engineer and shall be performed during a period of dry weather.
- E. Subsequent to proof-rolling, and just prior to placement of fill, the exposed subgrade within the construction areas shall be evaluated for moisture and density. The subgrade soils shall be at or above the optimum moisture content, and have an in-place dry density of at least 95 percent of the standard effort (ASTM D698) maximum dry density of the in-situ soils. If the moisture or density does not meet the above criteria, the subgrade shall be scarified to a minimum depth of 6 inches, and moisture adjusted to meet the requirements per the soils report as indicated on the Construction Documents.
- F. If remediation is required, Contractor shall have any of the following remediation options:
1. Disking and drying with natural means (if the construction schedule allows).
 2. Dry the surface soils by chemically treatment.
 3. Remove the unsuitably wet soils and replace the wet soil with select fill having an acceptable moisture content.

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The option will be entirely up to the Contractor and no extra will be paid by the Owner.

- G. After proof-rolling and undercutting has been completed, and the subgrade tested and adjusted as necessary, fill placement may begin. The first layer of fill shall be placed in a relatively uniform horizontal lift and be adequately keyed into the stripped subgrade soils.
- H. Refer to construction drawings for information regarding lime-stabilized subgrade treatment.

3.3 FILL PLACEMENT

- A. Structural fill materials shall be as specified in Paragraph 2.1, A above. Structural fill shall be placed in maximum lifts of eight (8) inches of loose material and shall have a moisture content as indicated on the Construction Documents. If water must be added, it shall be uniformly applied and thoroughly mixed into the soil by disking or scarifying. Each lift of structural fill shall be tested by a representative of the geotechnical engineer prior to placement of subsequent lifts.
- B. Each lift of structural fill shall be compacted as required per the soils report and as indicated on the Construction Documents. Care shall be taken to apply compactive effort throughout the fill and fill scope areas. The moisture content and the degree of compaction of the structural fill soils shall be maintained until the construction of structures above them.
- C. Contractor shall be responsible for damage caused to structure because of over excavation or excavations left open during inclement weather. Should the subgrade, for any reason or cause, lose the required stability, density, or finish before the foundation structure is placed, it shall be re-compacted and refinished at the sole expense of the Contractor.

3.4 GRADING

- A. Rough Grading: Contractor shall control the grading around building so that ground is pitched to prevent water from running into the excavated areas or damaging other structures. Furnish pumping required to keep excavated spaces clear of water during construction. If a foundation excavation must remain empty through a shut-down period, cover with boards and building paper and clean out immediately when work resumes. If any subgrade should be damaged due to flooding, damaged area shall be removed and filled with select fill.
- B. Finish Grading:
 - 1. After rough grading is completed, provide and place imported top soil in the amounts required to bring the rough grade to within two (2) inches of finish grade. This earth fill shall be placed in lifts not to exceed 12 inches after compaction and shall be compacted to a dry density of at least 95 percent of the ASTM D698 maximum dry density.
 - 2. Assure bonding of layers of fill material in compliance with the specifications.
 - 3. Final and fine grading shall be done using a tractor pulled landscape rake and hand raking removing all debris immediately prior to landscaping. The final graded ground surface shall be relatively smooth, free of organic material and in suitable condition to commence landscaping work.

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- C. Topsoil:
 - 1. Contractor shall furnish all topsoil that may be required to provide finish elevations. Topsoil material shall meet requirements of Paragraph 2.1 of this Section. Spread minimum two (2) inches of topsoil over graded areas after rough grading has been completed.
 - 2. At the completion of finish grading, ground surface shall be relatively smooth, free of organic material and in suitable condition to commence landscaping work.

3.5 INSPECTION AND TESTING LABORATORY SERVICES

- A. Refer to Section 01 4523, Inspection and Testing Laboratory Services for laboratory services to determine the liquid limit, plastic limit and plasticity index for soils and in-place density tests for compacted material.
- B. The Contractor shall cooperate with the inspection and testing laboratory in all matters pertaining to the work.

END OF SECTION

SECTION 31 06 20.15 - CEMENT STABILIZED SAND

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Cement stabilized sand.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices:
 - 1. No payment will be made for cement stabilized sand under this Section unless specifically noted in bid documents. Include payment for cement stabilized sand in unit price for applicable utility or structure installation section.
- B. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 REFERENCES

- A. ASTM C 33 - Standard Specification for Concrete Aggregates (Fine Aggregate).
- B. ASTM C 40 - Standard Test Method for Organic Impurities in Fine Aggregates for Concrete.
- C. ASTM C 42 - Standard Test Methods for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
- D. ASTM C 94 - Standard Specification for Ready-Mixed Concrete.
- E. ASTM C 123 - Standard Test Method for Lightweight Particles in Aggregate.
- F. ASTM C 142 - Standard Test Method for Clay Lumps and Friable Particles in Aggregates.
- G. ASTM C 150 - Specification for Portland Cement.
- H. ASTM D 558 - Standard Test Method for Moisture-Density Relations of Soil Cement-Mixtures.
- I. ASTM D 1632 - Standard Practice for Making and Curing Soil-Cement Compression and Flexure Test Specimens in the Laboratory.
- J. ASTM D 1633 - Standard Test Method for Compressive Strength of Molded Soil-Cement Cylinders.
- K. ASTM D 2487 - Standard Test Method for Classification of Soils for Engineering Purposes (Unified Soil Classification System).
- L. ASTM D2922 - Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
- M. ASTM D 3665 - Standard Practice for Random Sampling of Construction Materials.
- N. ASTM D 4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

1.4 SUBMITTALS

- A. Conform to requirements of Division 1.
- B. Submit proposed target cement content and production data for sand-cement mixture in accordance with requirements of Paragraph 2.03, Materials Qualifications.

1.5 DESIGN REQUIREMENTS

- A. Use sand-cement mixture producing minimum unconfined compressive strength of 100 pounds per square inch (psi) in 48 hours.
 - 1. Design will be based on strength specimens molded in accordance with ASTM D 558 at moisture content within 3 percent of optimum and within 4 hours of batching.
 - 2. Determine minimum cement content from production data and statistical history. Provide no less than 1.5 sacks of cement per ton of dry sand.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Cement: Type I Portland cement conforming to ASTM C 150.
- B. Sand: Clean, durable sand meeting grading requirements for fine aggregates of ASTM C 33, or requirements for bank run sand of Division 2 and the following requirements:
 - 1. Classified as SW, SP, SW-SM, SP-SM, or SM by Unified Soil Classification System of ASTM D 2487.
 - 2. Deleterious materials:
 - a. Clay lumps, ASTM C 142 - less than 0.5 percent.
 - b. Lightweight pieces, ASTM C 123; less than 5.0 percent.
 - c. Organic impurities, ASTM C 40, color no darker than standard color.
 - 3. Plasticity index of 4 or less when tested in accordance with ASTM D 4318.
- C. Water: Potable water, free of oils, acids, alkalies, organic matter or other deleterious substances, meeting requirements of ASTM C 94.

2.2 MIXING MATERIALS

- A. Add required amount of water and mix thoroughly in pugmill-type mixer.
- B. Stamp batch ticket at plant with time of loading. Reject material not placed and compacted within 4 hours after mixing.

2.3 MATERIAL QUALIFICATION

- A. Determine target cement content of material as follows:
 - 1. Obtain samples of sand-cement mixtures at production facility representing range of cement content consisting of at least three points.
 - 2. Complete molding of samples within 4 hours after addition of water.
 - 3. Perform strength tests (average of two specimens) at 48 hours and 7 days.
 - 4. Perform cement content tests on each sample.
 - 5. Perform moisture content tests on each sample.
 - 6. Plot average 48-hour strength vs. cement content.

7. Record scale calibration date, sample date, sample time, molding time, cement feed dial settings, and silo pressure (if applicable).
- B. Test raw sand for following properties at point of entry into pug-mill:
1. Gradation
 2. Plasticity index
 3. Organic impurities
 4. Clay lumps and friable particles
 5. Lightweight pieces
 6. Moisture content
 7. Classification
- C. Present data obtained in format similar to that provided in sample data form attached to this Section.
- D. The target content may be adjusted when statistical history so indicates. For determination of minimum product performance use formula: $f'c\% \frac{1}{2}$ standard deviation

PART 3 EXECUTION

3.1 PLACING

- A. Place sand-cement mixture in maximum 12-inch-thick loose lifts and compact to 95 percent of maximum density as determined in accordance with ASTM D 558, unless otherwise specified. Refer to related specifications for thickness of lifts in other applications. Target moisture content during compaction is +3 percent of optimum. Perform and complete compaction of sand-cement mixture within 4 hours after addition of water to mix at plant.
- B. Do not place or compact sand-cement mixture in standing or free water.

3.2 FIELD QUALITY CONTROL

- A. Testing will be performed under provisions of Division 1.
- B. One sample of cement stabilized sand shall be obtained for each 150 tons of material placed per day with no less than one sample per day of production. Random samples of delivered cement stabilized sand shall be taken in the field at point of delivery in accordance with ASTM 3665. Obtain three individual samples of approximately 12 to 15 lb each from the first, middle, and last third of the truck and composite them into one sample for test purpose.
- C. Prepare and mold four specimens (for each sample obtained) in accordance with ASTM D 558, Method A, without adjusting moisture content. Samples will be molded at approximately same time material is being used, but no later than 4 hours after water is added to mix.
- D. After molding, specimens will be removed from molds and cured in accordance with ASTM D 1632.
- E. Specimens will be tested for compressive strength in accordance with ASTM D 1633, Method A. Two specimens will be tested at 48 hours plus or minus 2 hours and two specimens will be tested at 7 days plus or minus 4 hours.
- F. A strength test will be average of strengths of two specimens molded from same sample of material and tested at same age. Average daily strength will be average of strengths of all specimens molded during one day's production and tested at same age.

- G. Precision and Bias: Test results shall meet recommended guideline for precision in ASTM D 1633 Section 9.
- H. Reporting: Test reports shall contain, as a minimum, the following information:
 - 1. Supplier and plant number
 - 2. Time material was batched
 - 3. Time material was sampled
 - 4. Test age (exact hours)
 - 5. Average 48-hour strength
 - 6. Average 7-day strength
 - 7. Specification section number
 - 8. Indication of compliance / non-compliance
 - 9. Mixture identification 3
 - 10. Truck and ticket numbers
 - 11. The time of molding
 - 12. Moisture content at time of molding
 - 13. Required strength
 - 14. Test method designations
 - 15. Compressive strength data as required by ASTM D 1633
 - 16. Supplier mixture identification
 - 17. Specimen diameter and height, in.
 - 18. Specimen cross-sectional area, sq. in.

3.3 ACCEPTANCE

- A. Strength level of material will be considered satisfactory if:
 - 1. The average 48-hour strength is greater than 100 psi with no individual strength test below 70 psi.
 - 2. All 7-day individual strength tests (average of two specimens) are greater than or equal to 100 psi.
- B. Material will be considered deficient when 7-day individual strength test (average of two specimens) is less than 100 psi but greater than 70 psi. See Paragraph 3.04 Adjustment for Deficient Strength.
- C. The material will be considered unacceptable and subject to removal and replacement at Contractor's expense when individual strength test (average of two specimens) has 7-day strength less than 70 psi.
- D. When moving average of three daily 48-hour averages falls below 100 psi, discontinue shipment to project until plant is capable of producing material, which exceeds 100 psi at 48 hours. Five 48-hour strength tests shall be made in this determination with no individual strength tests less than 100 psi.
- E. Testing laboratory shall notify Contractor, Owner's Representative, and material supplier by facsimile of tests indicating results falling below specified strength requirements within 24 hours.
- F. If any strength test of laboratory cured specimens falls below the specified strength, Contractor may, at his own expense, request test of cores drilled from the area in question in accordance with ASTM C42. In such cases, three (3) cores shall be taken for each strength test that falls below the values given in 3.03.A.

- G. Cement stabilized sand in an area represented by core tests shall be considered satisfactory if the average of three (3) cores is equal to at least 100 psi and if no single core is less than 70 psi. Additional testing of cores extracted from locations represented by erratic core strength results will be permitted.

3.4 ADJUSTMENT FOR DEFICIENT STRENGTH

- A. When mixture produces 7-day compressive strength greater than or equal to 100 psi, then material will be considered satisfactory and bid price will be paid in full.
- B. When mixture produces 7-day compressive strength less than 100 psi and greater than or equal to 70 psi, material shall be accepted contingent on credit in payment. Compute credit by the following formula: $\text{Credit per Cubic Yard} = \$30.00 \times 2 (100 \text{ psi} - \text{Actual psi}) / 100$
- C. When mixture produces 7-day compressive strength less than 70 pounds per square inch, then remove and replace cement-sand mixture and paving and other necessary work at no cost to Owner.

END OF SECTION

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SECTION 31 06 20.17 - UTILITY BACKFILL MATERIALS

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Material Classifications.
- B. Utility Backfill Materials:
 - 1. Concrete sand
 - 2. Gem sand
 - 3. Pea gravel
 - 4. Crushed stone
 - 5. Crushed concrete
 - 6. Bank run sand
 - 7. Select backfill
 - 8. Random backfill
- C. Material Handling and Quality Control Requirements.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices:
 - 1. No payment will be made for backfill material unless specifically listed in the bid documents. Include payment in unit price for applicable utility installation.
- B. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 DEFINITIONS

- A. Unsuitable Material:
 - 1. Materials classified as ML, CL-ML, MH, PT, OH, and OL according to ASTM D 2487.
 - 2. Materials that cannot be compacted to required density due to gradation, plasticity, or moisture content.
 - 3. Materials containing large clods, aggregates, or stones greater than 4 inches in any dimension; debris, vegetation, or waste; or any other deleterious materials.
 - 4. Materials contaminated with hydrocarbons or other chemical contaminants.
- B. Suitable Material:
 - 1. Materials meeting specification requirements.
 - 2. Unsuitable materials meeting specification requirements for suitable soils after treatment with lime or cement.

- C. Foundation Backfill Materials: Natural soil or manufactured aggregate meeting Class I requirements and geotextile filter fabrics as required, to control drainage and material separation. Foundation backfill material is placed and compacted as backfill where needed to provide stable support for structure foundation base. Foundation backfill materials may include concrete fill and seal slabs.
- D. Foundation Base: Crushed stone aggregate with filter fabric as required, cement stabilized sand, or concrete seal slab. Foundation base provides smooth, level working surface for construction of concrete foundation.
- E. Backfill Material: Classified soil material meeting specified quality requirements for designated application as embedment or trench zone backfill.
- F. Embedment Material: Soil material placed under controlled conditions within embedment zone extending vertically upward from top of foundation to an elevation 12 inches above top of pipe, and including pipe bedding, haunching and initial backfill.
- G. Trench Zone Backfill: Classified soil material meeting specified quality requirements and placed under controlled conditions in trench zone from top of embedment zone to base course in paved areas or to surface grading material in unpaved areas.
- H. Foundation: Either suitable soil of trench bottom or material placed as backfill of over-excavation for removal and replacement of unsuitable or otherwise unstable soils.
- I. Source: Source selected by Contractor for supply of embedment or trench zone backfill material. Selected source may be project excavation, off-site borrow pits, commercial borrow pits, or sand and aggregate production or manufacturing plants.
- J. Refer to Division 33 for other definitions regarding utility installation by trench construction.

1.4 REFERENCES

- A. ASTM C 33 - Standard Specification for Concrete Aggregate.
- B. ASTM C 40 - Standard Test Method for Organic Impurities in Fine Aggregates for Concrete.
- C. ASTM C 123 - Standard Test Method for Lightweight Particles in Aggregate.
- D. ASTM C 131 - Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in Los Angeles Machine.
- E. ASTM C 136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
- F. ASTM C 142 - Standard Test Method for Clay Lumps and Friable Particles in Aggregates.
- G. ASTM D 1140 - Standard Test Method for Amount of Material in Soils Finer Than No. 200 Sieve.
- H. ASTM D 2487 - Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).
- I. ASTM D 4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
- J. ASTM D 4643 - Standard Test Method for Determination of Water (Moisture) Content of Soil by Microwave Oven Method.

- K. TxDOT Tex-110-E - Determining Particle Size Analysis of Soils.
- L. TxDOT Tex-460-A - Material Finer Than 75 Fm (No.200) Sieve In Mineral Aggregates (Decantation Test for Concrete Aggregates).

1.5 SUBMITTALS

- A. Conform to requirements of Division 1.
- B. Submit description of source, material classification and product description, production method, and application of backfill materials.
- C. Submit test results for samples of off-site backfill materials. Comply with Paragraph 2.03, Material Testing.
- D. Before stockpiling materials, submit copy of approval from landowner for stockpiling backfill material on private property.
- E. Provide delivery ticket which includes source location for each delivery of material that is obtained from off-site sources or is being paid as specific bid item.

1.6 TESTS

- A. Perform tests of sources for backfill material in accordance with Paragraph 2.03B.
- B. Verification tests of backfill materials may be performed by Owner in accordance with Division 1.

PART 2 PRODUCTS

2.1 MATERIAL CLASSIFICATIONS

- A. Classify materials for backfill for purpose of quality control in accordance with Unified Soil Classification Symbols as defined in ASTM D 2487. Material use and application is defined in utility installation specifications and Drawings either by class, as described in Paragraph 2.01B, or by product descriptions, as given in Paragraph 2.02.
- B. Class Designations Based on Laboratory Testing:
 - 1. Class I: Well-graded gravels and sands, gravel-sand mixtures, crushed well-graded rock, little or no fines (GW, SW):
 - a. Plasticity index: non-plastic.
 - b. Gradation: D60/D10 - greater than 4 percent; amount passing No. 200 sieve - less than or equal to 5 percent.
 - 2. Class II: Poorly graded gravels and sands, silty gravels, and sands, little to moderate fines (GM, GP, SP, SM):
 - a. Plasticity index: non-plastic to 4.
 - b. Gradations:
 - 1) Gradation (GP, SP): amount passing No. 200 sieve - less than 5 percent.
 - 2) Gradation (GM, SM): amount passing No. 200 sieve - between 12 percent and 50 percent.
 - 3) Borderline gradations with dual classifications (e.g., SP-SM): amount passing No. 200 sieve - between 5 percent and 12 percent.

3. Class III: Clayey gravels and sands, poorly graded mixtures of gravel, sand, silt, and clay (GC, SC, and dual classifications, e.g., SP-SC):
 - a. Plasticity index: greater than 7.
 - b. Gradation: amount passing No. 200 sieve - between 12 percent and 50 percent.
4. Class IVA: Lean clays (CL).
 - a. Plasticity Indexes:
 - 1) Plasticity index: greater than 7, and above A line.
 - 2) Borderline plasticity with dual classifications (CL-ML): PI between 4 and 7.
 - b. Liquid limit: less than 50.
 - c. Gradation: amount passing No. 200 sieve - greater than 50 percent.
 - d. Inorganic.
5. Class IVB: Fat clays (CH)
 - a. Plasticity index: above A line.
 - b. Liquid limit: 50 or greater.
 - c. Gradation: amount passing No. 200 sieve - greater than 50 percent.
 - d. Inorganic.
6. Use soils with dual class designation according to ASTM D 2487, and which are not defined above, according to more restrictive class.

2.2 PRODUCT DESCRIPTIONS

- A. Soils classified as silt (ML) silty clay (CL-ML with PI of 4 to 7), elastic silt (MH), organic clay and organic silt (OL, OH), and organic matter (PT) are not acceptable as backfill materials. These soils may be used for site grading and restoration in unimproved areas as approved by Owner's Representative. Soils in Class IVB, fat clay (CH) may be used as backfill materials where allowed by applicable backfill installation specification. Refer to Division 31.
- B. Provide backfill material that is free of stones greater than 6 inches, free of roots, waste, debris, trash, organic material, unstable material, non-soil matter, hydrocarbon or other contamination, conforming to following limits for deleterious materials:
 1. Clay lumps: Less than 0.5 percent for Class I, and less than 2.0 percent for Class II, when tested in accordance with ASTM C 142.
 2. Lightweight pieces: Less than 5 percent when tested in accordance with ASTM C 123.
 3. Organic impurities: No color darker than standard color when tested in accordance with ASTM C 40.
- C. Manufactured materials, such as crushed concrete, may be substituted for natural soil or rock products where indicated in product specification, and approved by Owner's Representative, provided that physical property criteria are determined to be satisfactory by testing.
- D. Bank Run Sand: Durable bank run sand classified as SP, SW, or SM by Unified Soil Classification System (ASTM D 2487) meeting following requirements:
 1. Less than 15 percent passing number 200 sieve when tested in accordance with ASTM D 1140. Amount of clay lumps or balls may not exceed 2 percent.
 2. Material passing number 40 sieve shall meet the following requirements when tested in accordance with ASTM D 4318: Plasticity index: not exceeding 7.
- E. Concrete Sand: Natural sand, manufactured sand, or combination of natural and manufactured sand conforming to requirements of ASTM C 33 and graded within following limits when tested in accordance with ASTM C 136:

| Sieve | Percent Passing |
|---------|-----------------|
| 3/8" | 100 |
| No. 4 | 95 to 100 |
| No. 8 | 80 to 100 |
| No. 16 | 50 to 85 |
| No. 30 | 25 to 60 |
| No. 50 | 10 to 30 |
| No. 100 | 2 to 10 |

- F. Gem Sand: Sand conforming to requirements of ASTM C 33 for course aggregates specified for number 8 size and graded within the following limits when tested in accordance with ASTM C 136:

| Sieve | Percent Passing |
|-------|-----------------|
| 3/8" | 95 to 100 |
| No. 4 | 60 to 80 |
| No. 8 | 15 to 40 |

- G. Pea Gravel: Durable particles composed of small, smooth, rounded stones or pebbles and graded within the following limits when tested in accordance with ASTM C 136:

| Sieve | Percent Passing |
|--------|-----------------|
| 1/2" | 100 |
| 3/8" | 85 to 100 |
| No. 4 | 10 to 30 |
| No. 8 | 0 to 10 |
| No. 16 | 0 to 5 |

- H. Crushed Aggregates: Crushed aggregates consist of durable particles obtained from an approved source and meeting the following requirements:

1. Materials of one product delivered for same construction activity from single source, unless otherwise approved by Owner's Representative.
2. Non-plastic fines.
3. Los Angeles abrasion test wear not exceeding 45 percent when tested in accordance with ASTM C 131.
4. Crushed aggregate shall have minimum of 90 percent of particles retained on No. 4 sieve with 2 or more crushed faces as determined by Tex-460-A, Part I.
5. Crushed stone: Produced from oversize plant processed stone or gravel, sized by crushing to predominantly angular particles from naturally occurring single source. Uncrushed gravel is not acceptable materials for embedment where crushed stone is shown on applicable utility embedment drawing details.

6. Crushed Concrete: Crushed concrete is an acceptable substitute for crushed stone as utility backfill. Gradation and quality control test requirements are same as crushed stone. Provide crushed concrete produced from normal weight concrete of uniform quality; containing particles of aggregate and cement material, free from other substances such as asphalt, reinforcing steel fragments, soil, waste gypsum (calcium sulfate), or debris.
7. Gradations, as determined in accordance with Tex-110-E.

| Sieve | Percent Passing by Weight for Pipe Embedment By Ranges of Nominal Pipes Sizes | | |
|-------|--|----------|----------|
| | >15" | 15" – 8" | < 8" |
| 1" | 95 – 100 | 100 | -- |
| ¾" | 60 – 90 | 90 – 100 | 100 |
| ½" | 25 – 60 | -- | 90 – 100 |
| 3/8" | -- | 20 – 55 | 40 – 70 |
| No. 4 | 0 – 5 | 0 – 10 | 0 – 15 |
| No. 8 | -- | 0 – 5 | 0 – 5 |

- I. Select Backfill: Class III clayey gravel or sand or Class IV lean clay with plasticity index between 7 and 20 or clayey soils treated with lime in accordance with Division 31 to meet plasticity criteria.
- J. Random Backfill: Any suitable soil or mixture of soils within Classes I, II, III and IV; or fat clay (CH) where allowed by applicable backfill installation specification. Refer to Division 31.
- K. Cement Stabilized Sand: Conform to requirements of Division 31.
- L. Concrete Backfill: Conform to Class B concrete as specified in Division 32.
- M. Flexible Base Course Material: Conform to requirements of applicable portions of Division 33.

2.3 MATERIAL TESTING

- A. Source Qualification. Perform testing to obtain tests by suppliers for selection of material sources and products not from the project site. Test samples of processed materials from current production representing material to be delivered. Use tests to verify that materials meet specification requirements. Repeat qualification test procedures each time source characteristics change or there is planned change in source location or supplier. Include the following qualification tests, as applicable:
 1. Gradation. Report complete sieve analyses regardless of specified control sieves from largest particle through No. 200 sieve.
 2. Plasticity of material passing No. 40 sieve.
 3. Los Angeles abrasion wear of material retained on No. 4 sieve.
 4. Clay lumps.
 5. Lightweight pieces.
 6. Organic impurities.
- B. Production Testing. Provide reports to Owner's Representative from an independent testing laboratory that backfill materials to be placed in Work meet applicable specification requirements.
- C. Assist Owner's Representative in obtaining material samples for verification testing at source or at production plant.

PART 3 EXECUTION

3.1 SOURCES

- A. Use of existing material in trench excavations is acceptable, provided applicable specification requirements are satisfied.
- B. Identify off-site sources for backfill materials at least 14 days ahead of intended use so that Owner's Representative may obtain samples for verification testing.
- C. Materials may be subjected to inspection or additional verification testing after delivery. Materials which do not meet requirements of specifications will be rejected. Do not use material which, after approval, has become unsuitable for use due to segregation, mixing with other materials, or by contamination. Once material is approved by Owner's Representative, expense for sampling and testing required to change to different material will be credited to Owner through change order.
- D. Bank run sand, select backfill, and random backfill, if available in project excavation, may be obtained by selective excavation and acceptance testing. Obtain additional quantities of these materials and other materials required to complete work from off-site sources.
- E. Owner does not represent or guarantee that any soil found in excavation work will be suitable and acceptable as backfill material.

3.2 MATERIAL HANDLING

- A. When backfill material is obtained from either commercial or non-commercial borrow pit, open pit to expose vertical faces of various strata for identification and selection of approved material to be used. Excavate selected material by vertical cuts extending through exposed strata to achieve uniformity in product.
- B. Establish temporary stockpile locations for practical material handling, control, and verification testing by Owner's Representative in advance of final placement. Obtain approval from landowner for storage of backfill material on adjacent private property.
- C. When stockpiling backfill material near project site, use appropriate covers to eliminate blowing of materials into adjacent areas and prevent runoff containing sediments from entering drainage system.
- D. Place stockpiles in layers to avoid segregation of processed materials. Load material by making successive vertical cuts through entire depth of stockpile.

3.3 FIELD QUALITY CONTROL

- A. Quality Control
 - 1. The Owner's Representative may sample, and test backfill at:
 - a. Sources including borrow pits, production plants and Contractor's designated off-site stockpiles.
 - b. On-site stockpiles.
 - c. Materials placed in Work.
 - 2. The Owner's Representative may re-sample material at any stage of work or location if changes in characteristics are apparent.

- B. Production Verification Testing: Owner's testing laboratory will provide verification testing on backfill materials, as directed by Owner's Representative. Samples may be taken at source or at production plant, as applicable.

END OF SECTION

SECTION 31 11 00 - CLEARING AND GRUBBING

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Removing surface debris and rubbish.
- B. Clearing site of plant life and grass.
- C. Removing trees and shrubs.
- D. Removing root system of trees and shrubs.
- E. Fence removal.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices:
 - 1. Payment for clearing and grubbing is on a per Acre basis.
- B. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 REGULATORY REQUIREMENTS

- A. Conform to applicable codes for disposal of debris.
- B. Coordinate clearing work with utility companies.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION

3.1 PREPARATION

- A. Verify that existing plant life and features designated to remain are identified and tagged.

3.2 PROTECTION

- A. Protect following from damage or displacement:
 - 1. Living trees located 3 feet or more outside of intersection of side slopes and original ground line.
 - 2. Plants other than trees and landscape features designated to remain.
 - 3. Utilities designated to remain.
 - 4. Bench marks, monuments, and existing structures designated to remain.

3.3 CLEARING

- A. Remove stumps, main root ball, and root system to:
 - 1. Depth of 24 inches below finished subgrade elevation in area bounded by lines two feet behind back of curbs.

2. Depth of 24 inches below finished surface of required cross section for other areas.
- B. Clear undergrowth and deadwood without disturbing subsoil.
- C. Remove vegetation from top soil scheduled for reuse.

3.4 REMOVAL

- A. Remove debris, rubbish, and extracted plant material life from site in accordance with requirements of Division 1.
- B. Remove on site fences. Materials generated from removal of fences become property of Contractor. Properly dispose of in accordance with applicable local, state and federal laws.

END OF SECTION

SECTION 31 22 00 - GRADING

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Removal of topsoil.
- B. Rough grading the site for site structures, building pads, and play fields.
- C. Replacement of topsoil and finish grading for planting.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.3 SUBMITTALS

- A. Project Record Documents: Accurately record actual locations of utilities remaining by horizontal dimensions, elevations or inverts, and slope gradients.

1.4 PROJECT CONDITIONS

- A. Protect above- and below-grade utilities that remain.
- B. Protect plants, lawns, rock outcroppings, and other features to remain as a portion of final landscaping.
- C. Protect bench marks survey, control points, existing structures, fences, sidewalks, paving, and curbs from grading equipment and vehicular traffic.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Topsoil - Soil Type: Topsoil excavated on-site.
 - 1. Graded.
 - a. Free of roots, rocks larger than 1/2 inch (12 mm), subsoil, debris, large weeds and foreign matter.
 - b. Provide imported topsoil conforming to the requirements of Division 32 as required.
 - 2. Other Fill Materials: Reference relevant sections of Division 32 and the Drawings.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that survey bench mark and intended elevations for the Work are as indicated.

3.2 PREPARATION

- A. Identify required lines, leveler contours, and datum.
- B. Stake and flag locations of known utilities.
- C. Locate, identify, and protect utilities that remain, from damage.
- D. Notify utility company to remove and relocate utilities.

3.3 ROUGH GRADING

- A. Remove topsoil from areas to be further excavated, re-landscaped, or degraded, without mixing with foreign materials.
- B. Do not remove topsoil when wet.
- C. Remove subsoil from areas to be further excavated, re-landscaped, or re-graded.
- D. Do not remove wet subsoil, unless it is subsequently processed to obtain optimum moisture content.
- E. When excavating through roots, perform work by hand and cut roots with sharp axe.
- F. See Division 31 Specifications for filling procedures.
- G. Benching Slopes: Horizontally bench existing slopes greater than 1:4 to key fill material to slope for firm bearing.
- H. Stability: Replace damaged or displaced subsoil to same requirements as for specified fill.

3.4 SOIL REMOVAL

- A. Stockpile excavated topsoil on site.
- B. Stockpile excavated subsoil on site.
- C. Stockpiles: Use areas designated on site, pile depth not to exceed 8 feet (2.5 m); protect from erosion.

3.5 FINISH GRADING

- A. Before Finish Grading:
 - 1. Verify building and trench backfilling have been inspected.
 - 2. Verify subgrade has been contoured and compacted.
- B. Remove debris, roots, branches, stones, in excess of 1/2 inch (13 mm) in size. Remove/Break-up soil clumps greater than 1" in size. Remove soil contaminated with petroleum products.
- C. Where topsoil is to be placed, scarify surface to depth of 3 inches (75 mm).
- D. In areas where vehicles or equipment have compacted soil, scarify surface to depth of 3 inches (75 mm).
- E. Place topsoil in areas where seeding is indicated.

- F. Place topsoil where required to level finish grade.
- G. Place topsoil to the following compacted thicknesses:
 - 1. Areas to be Seeded with Grass: 6 inches (150 mm).
 - 2. Areas to be Sodded: 4 inches (100 mm).
- H. Place topsoil during dry weather.
- I. Remove roots, weeds, rocks, and foreign material while spreading.
- J. Near plants spread topsoil manually to prevent damage.
- K. Fine grade topsoil to eliminate uneven areas and low spots. Maintain profiles and contour of subgrade.
- L. Lightly compact placed topsoil.

3.6 TOLERANCES

- A. Top Surface of Subgrade: Plus or minus 1/10 foot (30 mm) from required elevation.
- B. Top Surface of Finish Grade: Plus or minus 1/2 inch (13 mm).

3.7 FIELD QUALITY CONTROL

- A. See Division 1 and Division 31 for compaction density testing.

3.8 CLEANING AND PROTECTION

- A. Remove unused stockpiled topsoil and subsoil. Grade stockpile area to prevent standing water. Excess topsoil and subsoil to be removed at no additional cost to owner.
- B. Leave site clean and raked, ready to receive landscaping.

END OF SECTION

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SECTION 31 23 16.14 - TRENCH SAFETY SYSTEM

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Trench Safety System for the construction of trench excavations.
- B. Trench Safety System for structural excavations that fall under provisions of State and Federal trench safety laws.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices:
 - 1. Payment for Trench Safety is on a Linear Foot Basis.
- B. Stipulated Price (Lump Sum). The Contract is a Stipulated Price Contract, payment for work in this Section is included in the total Stipulated Price.

1.3 DEFINITIONS

- A. A trench shall be defined as a narrow excavation (in relation to its depth) made below the surface of the ground. In general, the depth is greater than the width, but the width of a trench (measured at the bottom) is not greater than 15 feet.
- B. The Trench Safety System requirements will apply to larger open excavations if the erection of structures or other installations limits the space between the excavation slope and the installation to dimensions equivalent of a trench as defined.
- C. Trench Safety Systems include but are not limited to sloping, sheeting, trench boxes or trench shields, sheet piling, cribbing, bracing, shoring, dewatering or diversion of water to provide adequate drainage.

1.4 SUBMITTALS

- A. Submittals shall conform to requirements of Division 1.
- B. Submit a safety program specifically for the construction of trench excavation. Design the Trench Safety Program to be in accordance with OSHA 29 CFR standards governing the presence and activities of individuals working in and around trench excavations.
- C. Construction and shop drawings containing deviations from OSHA standards or special designs shall be sealed by a licensed Engineer retained and paid by Contractor.
- D. Review of the safety program by the Engineer will only be in regard to compliance with this specification and will not constitute approval by the Engineer nor relieve Contractor of obligations under State and Federal trench safety laws.

1.5 REGULATORY REQUIREMENTS

- A. Install and maintain Trench Safety Systems in accordance with the detail specifications set out in the provision of Excavations, Trenching, and Shoring, Federal Occupation Safety and Health Administration (OSHA) Standards, 29 CFR, Part 1926, Subpart P, as amended, including Final Rule, published in the Federal Register Vol. 54, No. 209 on Tuesday, October 31, 1989. The sections that are incorporated into these specifications by reference include Sections 1926-650 through 1926-652.
- B. The Contractor is responsible for obtaining a copy of OSHA standards included in "Subpart P - Excavations" from the Federal Register Vol. 54, No. 209.
- C. Legislation that has been enacted by the Texas Legislature with regard to trench safety systems is hereby incorporated, by reference, into these specifications. Refer to Texas Health and Safety Code Ann., § 756.021 (Vernon 1991).
- D. Reference materials, if developed for a specific project, will be issued with the Bid Documents.

1.6 INDEMNIFICATION

- A. Contractor shall indemnify and hold harmless the Owner, its employees and agents, from any and all damages, costs (including, without limitation, legal fees, court costs, and the cost of investigation), judgments or claims by anyone for injury or death of persons resulting from the collapse or failure of trenches constructed under this Contract.
- B. Contractor acknowledges and agrees that this indemnity provision provides indemnity for the Owner in case the Owner is negligent either by act or omission in providing for trench safety, including, but not limited to safety program and design reviews, inspections, failures to issue stop work orders, and the hiring of the Contractor.

PART 2 PRODUCTS – Not Used

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install and maintain Trench Safety Systems in accordance with provisions of OSHA 29 CFR.
- B. Install specially designed Trench Safety Systems in accordance with the Contractor's trench excavation safety program for the locations and conditions identified in the program.
- C. A competent person, as identified in the Contractor's trench safety program, shall verify that trench boxes and other premanufactured systems are certified for the actual installation conditions.

3.2 INSPECTION

- A. Contractor, or Contractor's independently retained consultant, shall make daily inspections of the Trench Safety Systems to ensure that the installed systems and operations meet OSHA 29 CFR and other personnel protection regulations requirements.
- B. If evidence of possible cave-ins or slides is apparent, Contractor shall immediately stop work in the trench and move personnel to safe locations until necessary precautions have been taken by Contractor to safeguard personnel entering the trench.

- C. Maintain a permanent record of daily inspections.

3.3 FIELD QUALITY CONTROL

- A. Contractor shall verify specific applicability of the selected or specially designed Trench Safety Systems to each field condition encountered on the project.

END OF SECTION

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SECTION 31 23 33 - TRENCHING AND BACKFILLING

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Excavation, trenching, foundation, embedment, and backfill for installation of utilities, including manholes and other pipeline structures.

1.2 MEASUREMENT AND PAYMENT

- A. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 DEFINITIONS

- A. Pipe Foundation: Suitable and stable native soils that are exposed at trench subgrade after excavation to depth of bottom of bedding as shown on Drawings, or foundation backfill material placed and compacted in over-excavations.
- B. Pipe Bedding: Portion of trench backfill that extends vertically from top of foundation up to level line at bottom of pipe, and horizontally from one trench sidewall to opposite sidewall.
- C. Haunching: Material placed on either side of pipe from top of bedding up to springline of pipe and horizontally from one trench sidewall to opposite sidewall.
- D. Initial Backfill: Portion of trench backfill that extends vertically from springline of pipe (top of haunching) up to level line 12 inches above top of pipe, and horizontally from one trench sidewall to opposite sidewall.
- E. Pipe Embedment: Portion of trench backfill that consists of bedding, haunching and initial backfill.
- F. Trench Zone: Portion of trench backfill that extends vertically from top of pipe embedment up to pavement subgrade or up to final grade when not beneath pavement.
- G. Unsuitable Material: Unsuitable soil materials are the following:
 - 1. Materials that are classified as ML, CL-ML, MH, PT, OH, and OL according to ASTM D 2487.
 - 2. Materials that cannot be compacted to required density due to gradation, plasticity, or moisture content.
 - 3. Materials that contain large clods, aggregates, stones greater than 4 inches in any dimension, debris, vegetation, waste or any other deleterious materials.
 - 4. Materials that are contaminated with hydrocarbons or other chemical contaminants.
- H. Suitable Material: Suitable soil materials are those meeting specification requirements. Materials mixed with lime or cement that can be compacted to required density and meeting requirements for suitable materials may be considered suitable materials, unless otherwise indicated.
- I. Backfill: Suitable material meeting specified quality requirements placed and compacted under controlled conditions.

- J. Ground Water Control Systems: Installations external to trench, such as well points, eductors, or deep wells. Ground water control includes dewatering to lower ground water, intercepting seepage which would otherwise emerge from side or bottom of trench excavation, and depressurization to prevent failure or heaving of excavation bottom. Refer to Division 1.
- K. Surface Water Control: Diversion and drainage of surface water runoff and rain water away from trench excavation. Rain water and surface water accidentally entering trench shall be controlled and removed as part of excavation drainage.
- L. Excavation Drainage: Removal of surface and seepage water in trench by sump pumping and using drainage layer, as defined in ASTM D 2321, placed on foundation beneath pipe bedding or thickened bedding layer of Class I material.
- M. Trench Conditions are defined with regard to stability of trench bottom and trench walls of pipe embedment zone. Maintain trench conditions that provide for effective placement and compaction of embedment material directly on or against undisturbed soils or foundation backfill, except where structural trench support is necessary.
 - 1. Dry Stable Trench: Stable and substantially dry trench conditions exist in pipe embedment zone as result of typically dry soils or achieved by ground water control (dewatering or depressurization) for trenches extending below ground water level.
 - 2. Stable Trench with Seepage: Stable trench in which ground water seepage is controlled by excavation drainage.
 - a. Stable Trench with Seepage in Clayey Soils: Excavation drainage is provided in lieu of or to supplement ground water control systems to control seepage and provide stable trench subgrade in predominately clayey soils prior to bedding placement.
 - b. Stable Wet Trench in Sandy Soils: Excavation drainage is provided in embedment zone in combination with ground water control in predominately sandy or silty soils.
 - c. Unstable Trench: Unstable trench conditions exist in pipe embedment zone if ground water inflow or high water content causes soil disturbances, such as sloughing, sliding, boiling, heaving or loss of density.
- N. Sub-trench: Sub-trench is special case of benched excavation. Sub-trench excavation below trench shields or shoring installations may be used to allow placement and compaction of foundation or embedment materials directly against undisturbed soils. Depth of sub-trench depends upon trench stability and safety as determined by Contractor.
- O. Trench Dam: Placement of low permeability material in pipe embedment zone or foundation to prohibit ground water flow along trench.
- P. Over-excavation and Backfill: Excavation of subgrade soils with unsatisfactory bearing capacity or composed of otherwise unsuitable materials below top of foundation as shown on Drawings, and backfilled with foundation backfill material.
- Q. Foundation Backfill Materials: Natural soil or manufactured aggregate of controlled gradation, and geotextile filter fabrics as required, to control drainage and material separation. Foundation backfill material is placed and compacted as backfill to provide stable support for bedding. Foundation backfill materials may include concrete seal slabs.
- R. Trench Safety Systems include both protective systems and shoring systems as defined in Division 31.
- S. Trench Shield (Trench Box): Portable worker safety structure moved along trench as work proceeds, used as protective system and designed to withstand forces imposed on it by

cave-in, thereby protecting persons within trench. Trench shields may be stacked if so designed or placed in series depending on depth and length of excavation to be protected.

- T. Shoring System: Structure that supports sides of an excavation to maintain stable soil conditions and prevent cave-ins, or to prevent movement of ground affecting adjacent installations or improvements.
- U. Special Shoring: Shoring system meeting special shoring as specified in Paragraph 1.08, Special Shoring Design Requirements, for locations identified on Drawings.

1.4 REFERENCES

- A. ASTM C 12 - Standard Practice for Installing Vitrified Clay Pipe Lines.
- B. ASTM D 558 - Standard Test Methods for Moisture-Density Relations of Soil Cement Mixtures.
- C. ASTM D 698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft).
- D. ASTM D 1556 - Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method.
- E. ASTM D 2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity Flow Applications.
- F. ASTM D 2487 - Standard Classification of Soils for Engineering Purposes.
- G. ASTM D 2922 - Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
- H. ASTM D 3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
- I. ASTM D 4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
- J. TxDOT Tex-101-E - Preparing Soil and Flexible Base Materials for Testing.
- K. TxDOT Tex-110-E - Particle Size Analysis of Soils.
- L. Federal Regulations, 29 CFR Part 1926, Standards-Excavation, Occupational Safety and Health Administration (OSHA).

1.5 SCHEDULING

- A. Schedule work so that pipe embedment can be completed on same day that acceptable foundation has been achieved for each section of pipe installation, manhole, or other structures.

1.6 SUBMITTALS

- A. Conform to requirements of Division 1.
- B. Submit planned typical method of excavation, backfill placement and compaction including:
 - 1. Trench widths.

2. Procedures for foundation and pipe zone bedding placement, and trench backfill compaction.
 3. Procedures for assuring compaction against undisturbed soil when pre-manufactured trench safety systems are proposed.
- C. Submit backfill material sources and product quality information in accordance with requirements of Division 31.
 - D. Submit trench excavation safety program in accordance with requirements of Division 31. Include designs for special shoring meeting requirements defined in Paragraph 1.08, Special Shoring Design Requirements contained herein.
 - E. Submit record of location of utilities as installed, referenced to survey control points. Include locations of utilities encountered or rerouted. Give stations, horizontal dimensions, elevations, inverts, and gradients.
 - F. Submit 11 inch by 17 inch or 12 inch by 18 inch copy of Drawing with plotted utility or obstruction location titled "Critical Location Report" to Owner's Representative.

1.7 TESTS

- A. Testing and analysis of backfill materials for soil classification and compaction during construction will be performed by an independent laboratory provided by Owner in accordance with requirements of Division 1 and as specified in this Section.
- B. Perform backfill material source qualification testing in accordance with requirements of Division 31.

1.8 SPECIAL SHORING DESIGN REQUIREMENTS

- A. Have special shoring designed or selected by Contractor's Professional Engineer to provide support for sides of excavations, including soils and hydrostatic ground water pressures as applicable, and to prevent ground movements affecting adjacent installations or improvements such as structures, pavements and utilities. Special shoring may be a pre-manufactured system selected by Contractor's Professional Engineer to meet project site requirements based on manufacturer's standard design.

PART 2 PRODUCTS

2.1 EQUIPMENT

- A. Perform excavation with hydraulic excavator or other equipment suitable for achieving requirements of this Section.
- B. Use only hand-operated tamping equipment until minimum cover of 12 inches is obtained over pipes, conduits, and ducts. Do not use heavy compacting equipment until adequate cover is attained to prevent damage to pipes, conduits, or ducts.
- C. Use trench shields or other protective systems or shoring systems which are designed and operated to achieve placement and compaction of backfill directly against undisturbed native soil.
- D. Use special shoring systems where required which may consist of braced sheeting, braced soldier piles and lagging, slide rail systems, or other systems meeting requirements as specified in Paragraph 1.08, Special Shoring Design Requirements.

2.2 MATERIAL CLASSIFICATIONS

- A. Embedment and Trench Zone Backfill Materials: Conform to classifications and product descriptions of Division 31.
- B. Concrete Backfill: Conform to requirements for Class B concrete as specified in Division 31.
- C. Geotextile (Filter Fabric): Conform to requirements of Division 1.
- D. Concrete for Trench Dams: Concrete backfill or 3 sack premixed (bag) concrete.
- E. Timber Shoring Left in Place: Untreated oak.

PART 3 EXECUTION

3.1 STANDARD PRACTICE

- A. Install flexible pipe, including "semi-rigid" pipe, to conform to standard practice described in ASTM D 2321, and as described in this Section. Where an apparent conflict occurs between standard practice and requirements of this Section, this Section governs.
- B. Install rigid pipe to conform to standard practice described in ASTM C 12, and as described in this Section. Where an apparent conflict occurs between standard practice and requirements of this Section, this Section governs.
- C. Classification of material will be determined by Owner's Representative.

3.2 PREPARATION

- A. Establish traffic control to conform to requirements of Division 1. Maintain barricades and warning lights for streets and intersections affected by Work, and are considered hazardous to traffic movements.
- B. Perform work to conform to applicable safety standards and regulations. Employ trench safety system as specified in Division 31.
- C. Immediately notify agency or company owning any existing utility line which is damaged, broken, or disturbed. Obtain approval from Owner's Representative and agency for any repairs or relocations, either temporary or permanent.
- D. Remove existing pavements and structures, including sidewalks and driveways, to conform to requirements of Division 2, as applicable.
- E. Install and operate necessary dewatering and surface-water control measures to conform to Division 1. Provide stable trench to allow installation in accordance with Specifications.
- F. Maintain permanent benchmarks, monumentation, and other reference points. Unless otherwise directed in writing, replace those which are damaged or destroyed in accordance with Division 1.

3.3 CRITICAL LOCATION INVESTIGATION

- A. Horizontal and vertical location of various underground lines shown on Drawings, including but not limited to water lines, gas lines, storm sewers, sanitary sewers, telecommunication lines, electric lines or power ducts, pipelines, concrete and debris, are based on best information available but are only approximate locations. At Critical Locations shown on

Drawings, field verify horizontal and vertical locations of such lines within zone 2 feet vertically and 4 feet horizontally of proposed work.

1. Verify location of existing utilities minimum of 7 working days in advance of pipe laying activities based on daily pipe laying rate. Use extreme caution and care when uncovering these lines.
 2. Notify Owner's Representative in writing immediately upon identification of obstruction. In event of failure to identify obstruction in minimum of 7 days, Contractor will not be entitled to extra cost for downtime including, but not limited to, payroll, equipment, overhead, demobilization and remobilization, until 7 days has passed from time Owner's Representative is notified of obstruction.
- B. Notify involved utility companies of date and time that investigation excavation will occur and request that their respective utility lines be marked in field. Comply with utility or pipeline company requirements that their representative be present during excavation. Provide Owner's Representative with 48 hours notice prior to field excavation or related work.
- C. Survey vertical and horizontal locations of obstructions relative to project baseline and datum and plot on 12 inch by 18 inch copy of Drawings. For large diameter water lines, submit to Owner's Representative for approval, horizontal and vertical alignment dimensions for connections to existing lines, tied into project baseline, signed and sealed by R.P.L.S.

3.4 PROTECTION

- A. Protect trees, shrubs, lawns, existing structures, and other permanent objects outside of grading limits and within grading limits as designated on Drawings, and in accordance with requirements of Division 1.
- B. Protect and support above-grade and below-grade utilities which are to remain.
- C. Restore damaged permanent facilities to pre-construction conditions unless replacement or abandonment of facilities is indicated on Drawings.
- D. Take measures to minimize erosion of trenches. Do not allow water to pond in trenches. Where slides, washouts, settlements, or areas with loss of density or pavement failures or potholes occur, repair, recompact, and pave those areas at no additional cost to the Owner.

3.5 EXCAVATION

- A. Except as otherwise specified or shown on Drawings, install underground utilities in open cut trenches with vertical sides.
- B. Perform excavation work so that pipe, conduit, and ducts can be installed to depths and alignments shown on Drawings. Avoid disturbing surrounding ground and existing facilities and improvements.
- C. Determine trench excavation widths using following schedule as related to pipe outside diameter (O.D.).

| Nominal Pipe Size, Inches | Minimum Trench Width, Inches |
|---------------------------|------------------------------|
| Less than 18 | O.D. + 24 |
| 18 to 30 | O.D. + 24 |

| | |
|------------------------|------------------|
| 36 to 42 | O.D. + 36 |
| <u>Greater than 42</u> | <u>O.D. + 48</u> |

- D. Use sufficient trench width or benches above embedment zone for installation of well point headers or manifolds and pumps where depth of trench makes it uneconomical or impractical to pump from surface elevation. Provide sufficient space between shoring cross braces to permit equipment operations and handling of forms, pipe, embedment and backfill, and other materials.
- E. Upon discovery of unknown utilities, badly deteriorated utilities not designated for removal, or concealed conditions, discontinue work at that location. Notify Owner's Representative and obtain instructions before proceeding.
- F. Shoring of Trench Walls.
 - 1. Install Special Shoring in advance of trench excavation or simultaneously with trench excavation, so that soils within full height of trench excavation walls will remain laterally supported at all times.
 - 2. For all types of shoring, support trench walls in pipe embedment zone throughout installation. Provide trench wall supports sufficiently tight to prevent washing trench wall soil out from behind trench wall support.
 - 3. Leave sheeting driven into or below pipe embedment zone in place to preclude loss of support of foundation and embedment materials, unless otherwise directed by Owner's Representative. Leave rangers, walers, and braces in place as long as required to support sheeting, which has been cut off, and trench wall in vicinity of pipe zone.
 - 4. Employ special methods for maintaining integrity of embedment or foundation material. Before moving supports, place and compact embedment to sufficient depths to provide protection of pipe and stability of trench walls. As supports are moved, finish placing and compacting embedment.
 - 5. If sheeting or other shoring is used below top of pipe embedment zone, do not disturb pipe foundation and embedment materials by subsequent removal. Maximum thickness of removable sheeting extending into embedment zone shall be equivalent of 1-inch-thick steel plate. As sheeting is removed, fill in voids left with grouting material.
- G. Use of Trench Shields. When trench shield (trench box) is used as worker safety device, the following requirements apply:
 - 1. Make trench excavations of sufficient width to allow shield to be lifted or pulled freely, without damage to trench sidewalls.
 - 2. Move trench shields so that pipe, and backfill materials, after placement and compaction, are not damaged nor disturbed, nor degree of compaction reduced. Re-compact after shield is moved if soil is disturbed.
 - 3. When required, place, spread, and compact pipe foundation and bedding materials beneath shield. For backfill above bedding, lift shield as each layer of backfill is placed and spread. Place and compact backfill materials against undisturbed trench walls and foundation.
 - 4. Maintain trench shield in position to allow sampling and testing to be performed in safe manner.
 - 5. Conform to applicable Government regulations.

- H. Voids under or damages to paving area outside shield caused by Contractor's work will require removal of pavement, consolidation and replacement of pavement in accordance with Contract Documents. Repair damage resulting from failure to provide adequate supports. Contractor is responsible for all cost associated with the repairs.
- I. Place sand or soil behind shoring or trench shield to prevent soil outside shoring from collapsing and causing voids under pavement. Immediately pack suitable material in outside voids following excavation to avoid caving of trench walls.
- J. Coordinate excavation within 15 feet of pipeline with company's representative. Support pipeline with methods agreed to by pipeline company's representative. Use small, rubber-tired excavator, such as backhoe, to do exploratory excavation. Bucket that is used to dig in close proximity to pipelines shall not have teeth or shall have guard installed over teeth to approximate bucket without teeth. Excavate by hand within 1 foot of Pipeline Company's line. Do not use larger excavation equipment than normally used to dig trench in vicinity of pipeline until pipelines have been uncovered and fully exposed. Do not place large excavation and hauling equipment directly over pipelines unless approved by Pipeline Company's representative.
- K. When, during excavation to uncover pipeline company's pipelines, screwed collar or an oxy-acetylene weld is exposed, immediately notify Owner's Representative. Provide supports for collar or welds. Discuss with Pipeline Company's representative and determine methods of supporting collar or weld during excavation and later backfilling operations. When collar is exposed, request Pipeline Company to provide welder in a timely manner to weld ends of collar prior to backfilling of excavation.

3.6 HANDLING EXCAVATED MATERIALS

- A. Use only excavated materials, which are suitable as defined in this Section and conforming to Division 31. Place material suitable for backfilling in stockpiles at distance from trench to prevent slides or cave-ins.
- B. When required, provide additional backfill material conforming to requirements of Division 31.
- C. Do not place stockpiles of excess excavated materials on streets and adjacent properties. Protect backfill material to be used on site. Maintain site conditions in accordance with Division 1. Excavate trench so that pipe is centered in trench. Do not obstruct sight distance for vehicles utilizing roadway or detours with stockpiled materials.

3.7 TRENCH FOUNDATION

- A. Excavate bottom of trench to uniform grade to achieve stable trench conditions and satisfactory compaction of foundation or bedding materials.
- B. When wet soil is encountered on trench bottom and dewatering system is not required, over excavate an additional 6 inches with approval by Owner's Representative. Place non-woven geotextile fabric and then compact 12 inches of crushed stone in one lift on top of fabric. Compact crushed stone with four passes of vibratory-type compaction equipment.
- C. Perform over excavation, if directed by Owner's Representative, in accordance with Paragraph 3.07B above. Removal of unstable or unsuitable material may be required if approved by Owner's Representative:
 - 1. Even though Contractor has not determined material to be unsuitable, or
 - 2. If unstable trench bottom is encountered and an adequate ground water control system is installed and operating according to Division 1.

- D. Place trench dams in Class I foundations in line segments longer than 100 feet between manholes and not less than one in every 500 feet of pipe placed. Install additional dams as needed to achieve workable construction conditions. Do not place trench dams closer than 5 feet from manholes.

3.8 PIPE EMBEDMENT, PLACEMENT, AND COMPACTION

- A. Remove loose, sloughing, caving, or otherwise unsuitable soil from bottoms and sidewalls of trenches immediately prior to placement of embedment materials.
- B. Place embedment including bedding, haunching, and initial backfill as shown on Drawings.
- C. For pipe installation, manually spread embedment materials around pipe to provide uniform bearing and side support when compacted. Protect flexible pipe from damage during placing of pipe zone bedding material. Perform placement and compaction directly against undisturbed soils in trench sidewalls, or against sheeting which is to remain in place.
- D. Do not place trench shields or shoring within height of embedment zone unless means to maintain density of compacted embedment material are used. If moveable supports are used in embedment zone, lift supports incrementally to allow placement and compaction of material against undisturbed soil.
- E. Place geotextile to prevent particle migration from in-situ soil into open-graded (Class I) embedment materials or drainage layers.
- F. Do not damage coatings or wrappings of pipes during backfilling and compacting operations. When embedding coated or wrapped pipes, do not use crushed stone or other sharp, angular aggregates.
- G. Place haunching material manually around pipe and compact it to provide uniform bearing and side support. If necessary, hold small-diameter or lightweight pipe in place during compaction of haunch areas and placement beside pipe with sand bags or other suitable means.
- H. Place electrical conduit, if used, directly on foundation without bedding.
- I. Shovel in-place and compact embedment material using pneumatic tampers in restricted areas, and vibratory-plate compactors or engine-powered jumping jacks in unrestricted areas. Compact each lift before proceeding with placement of next lift. Water tamping is not allowed.
- J. For water lines construction embedment, use bank run sand, concrete sand, gem sand, pea gravel, or crushed limestone as specified in Division 31. For water lines adhere to the following subparagraph numbers 1 and 2; for utility installation other than water, adhere to numbers 3 and 4 below:
 - 1. Class I, II and III Embedment Materials:
 - a. Maximum 6 inches compacted lift thickness.
 - b. Compact to achieve minimum of 95 percent of maximum dry density as determined according to ASTM D 698.
 - c. Moisture content to be within -3 percent to +5 percent of optimum as determined according to ASTM D 698, unless otherwise approved by Owner's Representative.
 - 2. Cement Stabilized Sand (where required for special installations):
 - a. Maximum 6 inches compacted thickness.

- b. Compact to achieve minimum of 95 percent of maximum dry density as determined according to ASTM D 698.
 - c. Moisture content to be on dry side of optimum as determined according to ASTM D 698 but sufficient for effective hydration.
 - 3. Class I Embedment Materials.
 - a. Maximum 6-inches compacted lift thickness.
 - b. Systematic compaction by at least two passes of vibrating equipment. Increase compaction effort as necessary to effectively embed pipe to meet deflection test criteria.
 - c. Moisture content as determined by Contractor for effective compaction without softening soil of trench bottom, foundation or trench walls.
 - 4. Class II Embedment and Cement Stabilized Sand.
 - a. Maximum 6-inches compacted thickness.
 - b. Compaction by methods determined by Contractor to achieve minimum of 95 percent of maximum dry density as determined according to ASTM D 698 for Class II materials and according to ASTM D 558 for cement stabilized materials.
 - c. Moisture content of Class II materials within 3 percent of optimum as determined according to ASTM D 698. Moisture content of cement stabilized sands on dry side of optimum as determined according to ASTM D 558 but sufficient for effective hydration.
- K. Place trench dams in Class I embedment in line segments longer than 100 feet between manholes, and not less than one in every 500 feet of pipe placed. Install additional dams as needed to achieve workable construction conditions. Do not place trench dams closer than 5 feet from manholes.

3.9 TRENCH ZONE BACKFILL PLACEMENT AND COMPACTION

- A. Place backfill for pipe or conduits and restore surface as soon as practicable. Leave only minimum length of trench open as necessary for construction.
- B. For water lines, backfill in trench zone, including auger pits, intermediate and site pits, with bank run sand, select fill, or random backfill material as specified in Division 31.
- C. For sewer pipes, use backfill materials described by trench limits. For "trench zone backfill" under pavement and to within one foot back of curb, use cement stabilized sand to level 12 inches below the pavement. For sewer pipes under natural ground backfill from 12 inches above top of pipe to 6" inches below finish grade with suitable on-site material or select backfill. Use select backfill for rigid pavements or flexible base material for asphalt pavements for 12- inch backfill directly under pavement. Use topsoil for 6-inch backfill directly under natural grade. For backfill materials reference Division 31.
- D. Where damage to completed pipe installation work is likely to result from withdrawal of sheeting, leave sheeting in place. Cut off sheeting 1.5 feet or more above crown of pipe. Remove trench supports within 5 feet from ground surface.
- E. When shown on Drawings, random backfill of suitable material may be used in trench zone for trench excavations outside pavements.
- F. Place trench zone backfill in lifts and compact. Fully compact each lift before placement of next lift.
 - 1. Class I, II, III or IV or combination thereof (Random Backfill):
 - a. Maximum 9-inches compacted lift thickness.

- b. Compact by vibratory equipment to minimum of 95 percent of maximum dry density determined according to ASTM D 698.
 - c. Moisture content within zero percent to +5 percent of optimum determined according to ASTM D 698, unless otherwise approved by Owner's Representative.
 - 2. Cement-Stabilized Sand:
 - a. Maximum lift thickness determined by Contractor to achieve uniform placement and required compaction, but do not exceed 12 inches.
 - b. Compact by vibratory equipment to minimum of 95 percent of maximum dry density determined according to ASTM D 558.
 - c. Moisture content on dry side of optimum determined according to ASTM D 558 but sufficient for cement hydration.
 - 3. Select Backfill:
 - a. Place in maximum 8-inch loose layers.
 - b. Compaction by equipment providing tamping or kneading impact to minimum of 95 percent of maximum dry density determined according to ASTM D 698.
 - c. Moisture content within 2 percent below or 5 percent above optimum determined according to ASTM D 698, unless approved by Owner's Representative.
- G. Unless otherwise shown on Drawings, for trench excavations not under pavement, random backfill of suitable material may be used in trench zone.
 - 1. Fat clays (CH) may be used as trench zone backfill outside paved areas at Contractor's option. When required density is not achieved, at no additional cost to Owner, rework, dry out, use lime stabilization or other approved methods to achieve compaction requirements, or use different suitable material.
 - 2. Maximum 9-inch compacted lift thickness for clayey soils and maximum 12-inch lift thickness for granular soils.
 - 3. Compact to minimum of 90 percent of maximum dry density determined according to ASTM D 698.
 - 4. Moisture content as necessary to achieve density.
- H. For electric conduits, remove form work used for construction of conduits before placing trench zone backfill.

3.10 MANHOLES, INLETS, JUNCTION BOXES AND OTHER PIPELINE STRUCTURES

- A. Meet requirements of adjoining utility installations for backfill of pipeline structures, as shown on Drawings.
- B. Below paved areas, encapsulate structure with cement stabilized sand; minimum of 1 foot below base, minimum 2 foot around walls, up to within 12 inches of pavement subgrade. Compact in accordance with Paragraph 3.9.F.2 of this Section. Use select backfill for rigid pavements or flexible base material for asphalt pavements for 12- inch backfill directly under pavement.
- C. In unpaved areas, encapsulate structure with cement stabilized sand; minimum of 1 foot below base, minimum 2 foot around walls, up to within 12 inches of finish grade. Compact in accordance with Paragraph 3.9.F.2 of this Section. Use suitable on-site material and topsoil for the 12-inch backfill directly under natural ground.

3.11 FIELD QUALITY CONTROL

- A. Test for material source qualifications as defined in Division 1.
- B. Provide excavation and trench safety systems at locations and to depths required for testing and retesting during construction at no additional cost to Owner.
- C. Tests will be performed on minimum of three different samples of each material type for plasticity characteristics, in accordance with ASTM D 4318, and for gradation characteristics, in accordance with Tex-101-E and Tex-110-E. Additional classification tests will be performed whenever there is noticeable change in material gradation or plasticity, or when requested by Owner's Representative.
- D. At least three tests for moisture-density relationships will be performed initially for backfill materials in accordance with ASTM D 698, and for cement- stabilized sand in accordance with ASTM D 558. Perform additional moisture-density relationship tests once a month or whenever there is noticeable change in material gradation or plasticity.
- E. In-place density tests of compacted pipe foundation, embedment and trench zone backfill soil materials will be performed according to ASTM D 1556, or ASTM D 2922 and ASTM D 3017, and at following frequencies and conditions.
 - 1. For open cut construction projects and auger pits: Unless otherwise approved by Owner's Representative, successful compaction to be measured by one test per 40 linear feet measured along pipe for compacted embedment and two tests per 40 linear feet measured along pipe for compacted trench zone backfill material. Length of auger pits to be measured to arrive at 40 linear feet.
 - 2. A minimum of three density tests for each full shift of Work.
 - 3. Density tests will be distributed among placement areas. Placement areas are: foundation, bedding, haunching, initial backfill and trench zone.
 - 4. The number of tests will be increased if inspection determines that soil type or moisture content are not uniform or if compacting effort is variable and not considered sufficient to attain uniform density, as specified.
 - 5. Density tests may be performed at various depths below fill surface by pit excavation. Material in previously placed lifts may therefore be subject to acceptance/rejection.
 - 6. Two verification tests will be performed adjacent to in-place tests showing density less than acceptance criteria. Placement will be rejected unless both verification tests show acceptable results.
 - 7. Recompacted placement will be retested at same frequency as first test series, including verification tests.
 - 8. Identify elevation of test with respect to natural ground or pavement.
- F. Recondition, recompact, and retest at Contractor's expense if tests indicate Work does not meet specified compaction requirements. For hardened soil cement with nonconforming density, core and test for compressive strength at Contractor's expense.
- G. Acceptability of crushed rock compaction will be determined by inspection.

3.12 DISPOSAL OF EXCESS MATERIAL

- A. Dispose of excess materials in accordance with requirements of Division 1.

END OF SECTION

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.
 - 2. Slurry displacement-installed drilled piers.
 - 3. Dry-installed or slurry displacement-installed drilled piers at Contractor's choice.

1.3 UNIT PRICES

- A. Unit prices are included in Section 01 2200 "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:

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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 3000 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 SLURRY

- A. Slurry: Pulverized bentonite, pulverized attapulgite or polymers mixed with water to form stable colloidal suspension; complying with ACI 336.1 for density, viscosity, sand content, and pH

2.5 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.

2.6 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.7 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94, and furnish batch ticket information.

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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. Slurry Displacement Method: Stabilize excavation with slurry maintained a minimum of 60 inches above ground-water level and above unstable soil strata to prevent caving or sloughing of shaft. Maintain slurry properties before concreting.
- G. 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.

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1. Remove temporary casings, maintained in plumb position, during concrete placement and before initial set of concrete.
- H. 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.
- I. 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. Slurry Displacement Method: Place concrete in slurry-filled shafts by tremie methods or pumping. Control placement operations to ensure that tremie or pump pipe is embedded no fewer than *60 inches* into concrete and that flow of concrete is continuous from bottom to top of drilled pier.

- D. 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.
- E. 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.
- F. 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.
- G. 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.

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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. Properties of slurry and slurry test results at time of slurry placement and at time of concrete placement.
 12. Ground-water conditions and water-infiltration rate, depth, and pumping.
 13. 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.
 14. Description of soil or water movement, sidewall stability, loss of ground, and means of control.
 15. Bell dimensions and variations from original design.
 16. Date and time of starting and completing excavation.
 17. Inspection report.

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18. Condition of reinforcing steel and splices.
19. Position of reinforcing steel.
20. Concrete placing method, including elevation of consolidation and delays.
21. Elevation of concrete during removal of casings.
22. Locations of construction joints.
23. Concrete volume.
24. Concrete testing results.
25. 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

SECTION 32 11 13.13 - LIME-TREATED SUBGRADES

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Foundation course of lime stabilized natural subgrade material.

1.2 MEASUREMENT AND PAYMENT

- A. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 REFERENCES

- A. ASTM D698 - Tests for Moisture-Density Relations of Soils and Soil-Aggregate Mixture Using 5.5 lb Rammer and 12 inch Drop.
- B. ASTM D1140 - Method of Test for Amount of Material in Soils Finer than the No. 200 Sieve.
- C. ASTM D1556 - Density of Soil in Place by the Sand-Cone Method.
- D. ASTM D2922 - Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
- E. ASTM D3017 - Test Method for Moisture Content of Soil and Soil Aggregate in Place by Nuclear Methods (Shallow Depth).
- F. ASTM D4318 - Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
- G. TxDOT Tex-600-J - Lime Testing Procedure.
- H. Geotechnical Engineering Soils Report.

1.4 SUBMITTALS

- A. Submittals shall conform to requirements of Division 1.
- B. Submit certificates stating that hydrated lime, quicklime, or commercial lime slurry complies with these specifications.
- C. Submit weight tickets, certified by supplier, with each bulk delivery of lime to work site.
- D. Submit manufacturer's description and characteristics for rotary speed mixer and compaction equipment for approval.

1.5 TESTS

- A. Testing will be performed under provisions of Section - Testing Laboratory Services.
- B. Tests and analysis of soil materials will be performed in accordance with ASTM D4318.
- C. Sampling and testing of lime slurry shall be in accordance with Tex-600-J.

- D. Sample mixtures of hydrated lime or quicklime in slurry form will be tested to establish compliance with specifications.
- E. Soil will be evaluated to establish percent of hydrated lime, quicklime, or lime slurry to be applied to sub grade material.
- F. Moisture-density relationship will be established on material sample from roadway, after stabilization with lime, in accordance with ASTM D698.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Bagged lime shall bear manufacturer's name, product identification, and certified weight. Bags varying more than 5 percent of certified weight may be rejected; average weight of 50 random bags in each shipment shall not be less than certified weight.
- B. Store lime in weatherproof enclosures. Protect lime from ground dampness.
- C. Quicklime can be dangerous; exercise extreme caution if used for the Work. Contractor shall become informed about recommended precautions in the handling, storage and use of quicklime.

PART 2 PRODUCTS

2.1 WATER

- A. Water shall be clean; clear; and free from oil, acids, alkali, or vegetable matter.

2.2 LIME

- A. Type A - Hydrated lime: Dry material consisting essentially of calcium hydroxide or mixture of calcium hydroxide and an allowable percentage of calcium oxide and magnesium hydroxide.
- B. Type B - Commercial lime slurry: Liquid mixture consisting essentially of lime solids and water in slurry form. Water or liquid portion shall not contain dissolved material in sufficient quantity to be injurious or objectionable for purpose intended.
- C. Type C - Quicklime: Dry material consisting essentially of calcium oxide. Furnish quicklime in either of the following grades:
 - 1. Grade DS: Pebble quicklime of a gradation suitable for use in the preparation of a slurry for wet placing.
 - 2. Grade S: Finely-graded quicklime for use in the preparation of slurry for wet placing. Do not use grade S quicklime for dry placing.
- D. Lime shall conform to requirements of Item 260 of the 1993 Texas Department of Transportation Standard Specifications.
- E. Lime slurry may be delivered to the job site as commercial lime, or may be prepared at the job site by using hydrated lime or quicklime. The slurry shall be free of liquids other than water and shall be of a consistency that can be handled and uniformly applied without difficulty.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify compacted sub grade is ready to support imposed loads.
- B. Verify sub grade lines and grades are correct.

3.2 PREPARATION

- A. Complete backfill of new utilities below future grade.
- B. Cut material to bottom of sub grade using an approved cutting and pulverizing machine meeting following requirements:
 - 1. Cutters accurately provide a smooth surface over entire width of cut to plane of secondary grade.
 - 2. Visible indication that cut is to proper depth.
- C. Alternatively, scarify or excavate to bottom of stabilized sub grade. Remove material or windrow to expose secondary grade. Correct wet or unstable material below secondary grade by scarifying, adding lime, and compacting. Obtain uniform stability.

3.3 LIME SLURRY APPLICATION

- A. Mix hydrated lime or quicklime with water to form a slurry of the solids content specified. Commercial lime slurry shall have dry solids content as specified. Conform to cautionary requirements of Paragraph 1.06C concerning use of quicklime.
- B. Apply slurry with a distributor truck equipped with an agitator to keep lime and water in a consistent mixture. Make successive passes over measured section of roadway to attain proper moisture and lime content. Limit spreading to an area where preliminary mixing operations can be completed on the same working day.
- C. Apply so that dry sub grade will contain a minimum lime content of 7 percent by weight of dry sub grade unless otherwise instructed by Testing Laboratory.

3.4 PRELIMINARY MIXING

- A. Do not mix and place material when temperature is below 40 degrees F and falling. Base may be placed when temperature taken in shade and away from artificial heat is above 35 degrees F and rising.
- B. Use approved single-pass or multiple-pass rotary speed mixers to mix soil, lime, and water to required depth. Obtain a homogeneous friable mixture free of clods and lumps.
- C. Shape mixed sub grade to final lines and grades.
- D. Eliminate following operations and final mixing if pulverization requirements of Paragraph 3.05C can be met during preliminary mixing:
 - 1. Seal sub grade as a precaution against heavy rainfall by rolling lightly with light pneumatic rollers.
 - 2. Cure soil-lime material for 1 to 4 days. Keep sub grade moist during cure.

3.5 FINAL MIXING

- A. Use approved single-pass or multiple-pass rotary speed mixers to uniformly mix cured soil and lime to required depth.
- B. Add water to bring moisture content of soil mixture to a minimum of optimum or above.
- C. Mix and pulverize until all material passes a 1-3/4-inch sieve; a minimum of 85 percent, excluding nonslacking fractions, passes a 3/4-inch sieve; and a minimum of 60 percent excluding nonslacking fractions passes a No. 4 sieve.
- D. Shape mixed sub grade to final lines and grades.
- E. Do not expose hydrated lime to open air for 6 hours or more during interval between application and mixing. Avoid excessive hydrated lime loss due to washing or blowing.

3.6 COMPACTION

- A. Aerate or sprinkle to attain optimum moisture content as determined by Testing Laboratory. Remove and reconstruct sections where average moisture content exceeds ranges specified at time of final compaction.
- B. Start compaction immediately after final mixing, unless approved by Engineer.
- C. Spread and compact in two or more approximately equal layers where total compacted thickness is to be greater than 8 inches.
- D. Compact with approved heavy pneumatic or vibrating rollers, or a combination of tamping rollers and light pneumatic rollers. Begin compaction at the bottom and continue until entire depth is uniformly compacted.
- E. Do not allow stabilized base to mix with underlying material. Correct irregularities or weak spots immediately by replacing material and recompacting.
- F. Compact to following minimum densities at a moisture content of optimum to 3 percent above optimum as determined by ASTM D698, unless otherwise indicated on the Drawings:
 - 1. Areas to receive pavement without subsequent base course: Minimum density of 98 percent of maximum dry density.
 - 2. Areas to receive subsequent base course: Minimum density of 95 percent of maximum dry density.
- G. Seal with approved light pneumatic tired rollers: Prevent surface hair line cracking. Rework and recompact at areas where hair line cracking develops.

3.7 CURING

- A. Moist cure for a minimum of 3 days before placing base or surface course, or opening to traffic. Time may be adjusted as approved by Engineer. Sub grade may be opened to traffic after 2 days if adequate strength has been attained to prevent damage. Restrict traffic to light pneumatic rollers or vehicles weighing less than 10 tons.
- B. Keep sub grade surface damp by sprinkling. Roll with light pneumatic roller to keep surface knit together.

- C. Place base, surface, or seal course within 14 days after final mixing and compaction unless prior approval is obtained from the Engineer.

3.8 TOLERANCES

- A. Completed surface shall be smooth and conform to typical section and established lines and grades.
- B. Top of compacted surface: Plus or minus 1/4 inch in cross section or in 16 foot length.

3.9 FIELD QUALITY CONTROL

- A. Testing will be performed under provisions of Section - Testing Laboratory Services.
- B. A minimum of one phenolphthalein test will be made at random locations per 1000 linear feet per lane of roadway or 500 square yards of base to determine in-place depth.
- C. Contractor may, at his own expense, request additional cores in the vicinity of cores indicating nonconforming in-place depths. If the average of the tests falls below the required depth, place and compact additional material at no cost to the Owner.
 - 1. Compaction Testing will be performed in accordance with ASTM D1556 or ASTM D2922 and ASTM D3017 at random locations near depth determination tests. Rework and recompact areas that do not conform to compaction requirements at no cost to the Owner.
- D. Fill test sections with new compacted lime stabilized sub grade.

3.10 PROTECTION

- A. Maintain stabilized sub grade to lines and grades and in good condition until placement of base or surface course. Protect the asphalt membrane, if used, from being picked up by traffic.
- B. Repair defects immediately by replacing material to full depth.

END OF SECTION

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SECTION 32 11 26 - HOT MIX ASPHALT BASE COURSE

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Foundation course of compacted mixture of coarse and fine aggregates, and asphalt binder.

1.2 MEASUREMENT AND PAYMENT

- A. Unit prices.
 - 1. Payment for hot mix asphalt base is on per square yard basis.
 - 2. Payment for hot mix asphalt base for transitions and base repairs is on a per square yard basis.
 - 3. Payment for hot mix asphaltic base for temporary driveway, roadway shoulders, etc., is on a per square yard basis.
 - 4. Measurement for utility projects:
 - a. Match actual pavement replaced but no greater than maximum pavement replacement limits shown on Drawings.
 - b. Include installed hot mix asphalt base course material that extends one foot beyond outside edge of pavement to be replaced, except where proposed pavement section shares common edge with existing pavement section.
 - 5. Refer to Section 01270 – Measurement and Payment for unit price procedures.
- B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for Work in this Section is included in total Stipulated Price.

1.3 REFERENCES

- A. AASHTO T201 – Standard Specification for Kinematic Viscosity of Asphalts (Bitumens).
- B. AASHTO T202 – Standard Specification for Viscosity of Asphalt by Vacuum Capillary Viscometer.
- C. ASTM C 33 – Standard Specifications for Concrete Aggregate.
- D. ASTM C 131 – Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
- E. ASTM C 136 – Standard Method for Sieve Analysis of Fine and Coarse Aggregates.
- F. ASTM D 4402 – Standard Test Method for Viscosity Determination of Unfilled Asphalt Using the Brookfield Thermal Apparatus.
- G. TxDOT Tex-106-E – Calculating the Plasticity Index of Soils.
- H. TxDOT Tex-126-E – Molding, Testing, and Evaluating Bituminous Black Base Material.
- I. TxDOT Tex-200-F – Sieve Analysis of Fine and Coarse Aggregates.
- J. TxDOT Tex-203-F – Sand Equivalent Test

- K. TxDOT Tex-204-F – Design of Bituminous Mixtures.
- L. TxDOT Tex-207-F – Determining Density of Compacted Bituminous Mixtures.
- M. TxDOT Tex-208-F – Test for Stabilometer Value of Bituminous Mixtures.
- N. TxDOT Tex-227-F – Theoretical Maximum Specific Gravity of Bituminous Mixtures.

1.4 SUBMITTALS

- A. Conform to requirements of Section 01330 – Submittal Procedures.
- B. Submit certificates that asphalt materials and aggregates meet requirements of Paragraph 2.01, Materials.
- C. Submit proposed mix and test data for each type of base course in Work.
- D. Submit manufacturer's description and characteristics of mixing plant for approval.
- E. Submit manufacturer's description and characteristics of spreading and finishing machine for approval.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Coarse Aggregate:
 - 1. Use crushed gravel or crushed stone, or combination retained on No. 10 sieve, uniform in quality throughout and free from dirt, organic, or other injurious material occurring either free or as coating on aggregate. Conform aggregate on ASTM C 33 except for gradation. Furnish rock or gravel with Los Angeles abrasion loss not to exceed 40 percent by weight when tested in accordance with ASTM C 131.
 - 2. Reclaimed asphalt pavement (RAP) or reclaimed Portland cement concrete pavement (RPCCP) are permitted as aggregates for hot mix asphalt base course if combined aggregate criteria, gradation, and mixture properties are met.
- B. Fine Aggregate: Sand or stone screenings, or combination thereof, passing No. 10 sieve. Conform aggregate to ASTM C 33 except for gradation. Use sand composed of sound, durable stone particles free from loams or other deleterious foreign matter. Furnish screenings of same or similar material as specified for coarse aggregate. Plasticity index of that part of fine aggregate passing No. 40 sieve shall be not more than 6 when tested by TxDOT Tex-106-E. Sand equivalent shall have minimum value of 45 when tested by TxDOT Tex-203-F.

- C. Composite Aggregate: Conform to following limits when graded in accordance with ASTM C 136. Provide either coarse or fine aggregate where designated on the Drawings.

| GRADUATION OF COMPOSITE AGGREGATE | | |
|--|--------------------|------------------|
| Percent Passing by Weight or Volume | | |
| Sieve Size | Type A Coarse Base | Type B Fine Base |
| 1 1/2" | 100 | - |
| 1 1/4" | 95 to 100 | - |
| 1" | - | 100 |
| 7/8" | 70 to 90 | 95 to 100 |
| 5/8" | - | 75 to 95 |
| 1/2" | 50 to 70 | |
| 3/8" | - | 60 to 80 |
| #4 | 30 to 50 | 40 to 60 |
| #10 | 30 to 34 | 27 to 40 |
| #40 | 5 to 20 | 10 to 25 |
| #80 | 2 to 12 | 3 to 13 |
| #200 | 1 to 6* | 1 to 6* |
| VMA % Minimum | 11 | 12 |
| S *2 to 8 when Test Method Tex-200-F, Part II (Washed Sieve Analysis) is used. | | |

D. Asphalt Binder: Moisture-free homogeneous material meeting following requirements:

| SPECIFICATION | PG 64 -22 |
|---|-----------|
| Average 7-day Maximum Pavement Design Temperature, degrees C | <64 |
| Minimum Pavement Design Temperature, degrees C | >-22 |
| Original Binder | |
| Flash Point Temperature, T48, Minimum degrees C | 230 |
| Viscosity, ASTM D 4402, ^b Maximum 3 Pa.s (3000cP), Test Temperature, Degrees C | 135 |
| Dynamic Shear, TP5; ^c G*/sine[], Minimum, 1.00 kPa Test Temperature @ 10rad/sec, degrees C | 64 |
| Rolling Thin Film Oven (T240) or Thin Film Oven (T179) Residue | |
| Mass Loss, Maximum, % | -1.00 |
| Dynamic Shear, TP5; G*/sine[], Minimum, 2.20 kPa Test Temperature @ 10rad/sec, degrees C | 64 |
| Pressure Aging Vessel Residue (PPI) | |
| PAV Aging Temperature, degrees C ^d | 100 |
| Dynamic Shear, TP5, G*/sine[], Maximum, 5000 kPa Test Temperature @ 10rad/sec, degrees C | 25 |
| Physical Hardening ^e | Report |
| Creep Stiffness, TP1; ^f S, Maximum, 300 Mpa; m-value, Minimum, 0.300 Test Temperature @ 60 sec, degrees C | -12 |
| Direct Tension, TP3; ^f Failure Strain, Minimum, 1.0%; Test Temperature @ 1.0 mm/min, degrees C | -12 |
| <p>Notes:</p> <p>^a Pavement temperature can be estimated from air temperatures using algorithm contained in TxDOT testing procedures.</p> <p>^b The requirement may be waived at discretion of Project Manager if supplier warrants that asphalt binder can be adequately pumped and mixed at temperatures that meet applicable safety standards.</p> <p>^c For quality control of unmodified asphalt cement production, measurement of viscosity of original asphalt cement may be substituted for dynamic shear measurements of G*/sine[] at test temperature where asphalt is Newtonian fluid. Any suitable standard means of viscosity measurement may be used, including capillary or rotational viscometry (AASHTO T201 or T202).</p> <p>^d The PAV aging temperature is based on simulated climatic conditions and is one of three temperatures: 90 C, 100 C, or 110 C. The PAV aging temperature is 100 C for PG64 and PG70.</p> <p>^e Physical Hardening – TP 1 is performed on a set of asphalt beams according to Section 13.1, except conditioning time is extended to 24 hours plus or minus 10 minutes at 10 C above minimum performance temperature. The 24-hour stiffness and m-value are reported for information purposes only.</p> <p>^f If creep stiffness is below 300 MPa, the direct tension test is not required. If creep stiffness is between 300 and 600 MPa the direct tension failure strain requirement can be used in lieu of creep stiffness requirement. The m-value requirement must be satisfied in both cases.</p> | |

- E. Reclaimed asphalt pavement (RAP) may be used at a rate no greater than 20 percent.

2.2 EQUIPMENT

- A. Mixing Plant: Weight-batching or drum mix plant with capacity for producing continuous mixtures meeting specifications. With exception of a drum mix plant, the plant shall have satisfactory conveyors, power units, aggregate handling equipment, hot aggregate screens and bins, and dust collectors.
- B. Provide equipment to supply materials adequately in accordance with rated capacity of plant and produce finished material within specified tolerances. The following equipment is essential:
 - 1. Cold aggregate bins and proportioning device
 - 2. Dryer
 - 3. Screens
 - 4. Aggregate weight box and batching scales
 - 5. Mixes
 - 6. Asphalt storage and heating devices
 - 7. Asphalt measuring devices
 - 8. Truck scales
- C. Bins: Separate aggregate into minimum of four bins to produce consistently uniform grading and asphalt content in completed mix. One cold feet bin per stockpile is required.

2.3 MIXES

- A. Employ certified testing laboratory to prepare design mixes.
 - 1. Test in accordance with TxDOT Tex-126-E, TxDOT Tex-204-F, TxDOT Tex-208-F, and TxDOT Tex-227-F.
 - 2. Verify mixture design properties for plant-produced mixture. Demonstrate that asphalt plant is capable of producing mixture meeting design volumetric and stability requirements before placement begins.
- B. Density, Stability, and Air Voids, Requirements. Select asphalt binder content for base courses to result in 3 to 5 percent air voids in laboratory molded specimens, while meeting minimum VMA requirement for selected mixture classification.

| Percent Density Content | | Percent | HVEEM Stability Percent | Percent Asphalt | |
|-------------------------|-------------|----------------|-------------------------|-----------------|-------------|
| <u>Min.</u> | <u>Max.</u> | <u>Optimum</u> | Not Less Than | <u>Min.</u> | <u>Max.</u> |
| 94.5 | 97.5 | 96 | 35 | 3.5 | 7 |

PART 3 EXECUTION

3.1 PREPARATION

- A. Complete backfill of new utilities below future grade.
- B. Verify lines and grades are correct.

- C. Prepare subgrade in accordance with requirements of Section 02330 – Embankment and Section 02315 – Roadway Excavation or Section 2336 – Lime Stabilized Subgrade and Section 02337 – Lime/Fly-Ash Stabilized Subgrade, and 02338 – Portland Cement Stabilized Subgrade. Subgrade preparation may also refer to Section 02321 – Cement Stabilized Sand or Section 2713 – Recycled Crushed Concrete Base Course.
- D. Correct subgrade deviations in excess of plus or minus ¼ inch in cross section. Or in 16-foot length by loosening, adding or removing material, reshaping and recompacting by sprinkling and rolling.

3.2 PLACEMENT

- A. Place base when surface temperature taken in shade and away from artificial heat is above 40 degrees F and rising. Do not place asphalt base when temperature of surface to receive base course is below 50 degrees F and falling.
- B. Haul prepared and heated asphalt base mixture to project in tight vehicles previously cleaned of foreign material. Mixture shall be at temperature between 250 degrees F and 325 degrees F when laid.
- C. Place hot mix asphalt base course in compacted lifts no greater than 4 inches thick, unless permitted in writing by Engineer.
- D. Place courses as nearly continuously as possible. Place material with approved mechanical spreading and finishing machine of screening to tamping type. Spread lifts to attain smooth course of uniform density to section, line, and grades as indicated on Drawings.
- E. In areas with limited space where use of paver or front-end loader is impractical, spread by hand and compact asphalt by mechanical means. Carefully place materials to avoid segregation of mix; do not broadcast material. Remove lumps that do not break down readily.

3.3 JOINTS

- A. Transverse Joints. Pass roller over unprotected ends of freshly laid mixture only when mixture has cooled. When work is resumed, cut back placed material to produce slightly beveled edge for full thickness of course. Remove old material which has been cut away and lay new mix against fresh cut.
- B. Existing pavement. When new asphalt is laid against existing asphalt pavement, saw cut existing asphalt to full depth creating vertical face. Clean joint and apply tack coat before placement.

3.4 COMPACTION

- A. Construct test strip to identify correct type, number, and sequence of rollers necessary to obtain specified in-place density or air-voids. Prepare test strip at least 500 feet in length, comparable to placement and compaction conditions for Project.
- B. Begin rolling while pavement is still hot and as soon as it will bear roller without undue displacement or hair line cracking. Keep wheels properly moistened with water to prevent adhesion of surface mixture. Do not use excessive water; do not use petroleum by-products.

- C. Compact surface thoroughly and uniformly with power-driven equipment capable of obtaining required compaction. Obtain subsequent compression by starting at side and rolling longitudinally toward center of pavement, overlapping on successive trips by at least one-half width of rear wheels. Make alternate trips slightly different in length. Continue rolling until no further compression can be obtained and rolling marks are eliminated. Complete rolling before mat temperature drops below 175 degrees F.
- D. Along walls, curbs, headers, similar structures, and in locations not accessible to rollers, compact mixture thoroughly with lightly oiled tamps.
- E. Compact base course to a minimum density of 91 percent (TxDOT Tex-227-F).

3.5 TOLERANCES

- A. Pavement Repairs:
 - 1. Furnish templates for checking surface of finished sections. Maximum deflection of templates, when supported at center, shall not exceed $\frac{1}{4}$ inch.
 - 2. Completed surface, when tested with 10-foot straight edge laid parallel to center line of pavement, shall show no deviation in excess of $\frac{1}{4}$ inch in 10 feet. Correct surface not meeting this requirement.

3.6 FIELD QUALITY CONTROL

- A. Perform testing under provisions of Section 01454 – Testing Laboratory Services.
- B. For in-place depth and density, take minimum of one core at random locations for each 1000 feet of single lane pavement. On a 2-lane pavement, take samples at random every 500 feet from alternating lanes. Take cores for parking lots every 500 square yards of base to determine in-place depth and density. If cul-de-sac or streets are less than 500 feet, minimum of 2 cores (one per lane) will be procured. On small projects, take a minimum of two cores for each day's placement. For first day's placement and prior to coring, minimum of 5 nuclear gauge readings will be performed at each core location to establish correlation between nuclear gauge (wet density reading) and core (bulk density). This process will continue for each day's placement until engineer determines that a good bias has been established for that nuclear gauge.
- C. Determine in-lace density in accordance with TxDOT Tex-2507-F and Tex-227-F from cores or sections of asphaltic base located near each core. Other methods of determining in-place density, which correlate satisfactorily with results obtained from roadway specimens, may be used when approved by Project Manager.
- D. Request, at option, three additional cores within a 5-foot radius of core indicating nonconforming in-place depth at no additional cost to City. In-place depth at these locations shall be average depth of four cores.
- E. Fill cores and density tests sections with new compacted asphalt base or cold patch material.

3.7 NONCONFORMING PAVEMENT

- A. Recompact and retest nonconforming street sections not meeting surface test requirements. Patch asphalt pavement sections in accordance with procedures established by Asphalt Institute. Retesting is at no cost to the City.

- B. Remove and replace areas of asphalt base found deficient in thickness by more than 10 percent. Remove and replace areas of asphalt base found deficient in density. Use new asphalt base of thickness shown on Drawings.
- C. Replace or correct nonconforming pavement sections at no additional cost to the City.

3.8 PROTECTION

- A. Do not open base to traffic until 12 hours after completion of rolling, or as shown on Drawings.
- B. Maintain asphalt base in good condition until completion of Work.
- C. Repair defects immediately by replacing base to full depth.

END OF SECTION

**SECTION 32 11 26.10 –
FLEXIBLE BASE COURSE FOR TEMPORARY ROADS, DETOURS, SHOULDERS AND DRIVEWAYS**

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Foundation course of crushed concrete or stone.

1.2 UNIT PRICES

- A. Measurement for flexible base is on a square yard basis. Separate measurement will be made for each different required thickness of base course.
- B. Refer to Division 1 for unit price procedures.

1.3 REFERENCES

- A. ASTM D 1556 - Density of Soil in Place by the Sand-Cone Method.
- B. ASTM D 698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12.44 ft-lbf/ft³).
- C. ASTM D 6938 - Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
- D. ASTM D 361 - Test Method for Water Content of Soils and Rock in Place by Nuclear Methods (shallow depth).
- E. ASTM D 4318 - Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
- F. TxDOT Tex-101-E - Preparation of Soil and Flexible Base Materials for Testing.
- G. TxDOT Tex-110-E - Determination of Particle Size Analysis of Soils.

1.4 SUBMITTALS

- A. Submittals shall conform to requirements of Division 1.
- B. Submit samples of flexible base course and soil binder for testing.

1.5 TESTS

- A. Tests and analysis of soil materials will be performed in accordance with ASTM C 131, ASTM D 698, ASTM D 4318, Tex-101-E, and Tex-110-E under provisions of Division 1.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Provide materials from stockpiles that are protected during storage from spewing contaminants that would be detrimental to the flexible base course.

- B. Load materials from same area of stockpile to maintain uniformity of each successive delivery to the project site.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Crushed Stone or Concrete: Material retained on the No. 40 sieve meeting the following requirements:
 - 1. Durable particles of crusher-run broken limestone, crushed concrete, crushed sandstone, or granite obtained from an approved source.
- B. Soil Binder: Material passing the No. 40 sieve meeting the following requirements when tested in accordance with ASTM D 4318:
 - 1. Maximum Liquid Limit: 40
 - 2. Maximum Plasticity Index: 12
 - 3. Maximum Lineal Shrinkage: 7 (when calculated from volumetric shrinkage at liquid limit).
- C. Mixed Materials shall meet the following requirements:
 - 1. Minimum compressive strength of 35 psi at 0 psi lateral pressure and 175 psi at 15 psi lateral pressure using triaxial testing procedures.
 - 2. Grading in accordance with Tex-101-E and Tex-110-E within the following limits:

| <u>Sieve</u> | <u>Percent Retained</u> |
|--------------|-------------------------|
| 1-3/4 inch | 0 to 10 |
| No. 4 | 45 to 75 |
| No. 40 | 60 to 85 |

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify compacted subgrade is ready to support imposed loads.
- B. Verify lines and grades are correct.

3.2 PREPARATION

- A. Complete backfill of new utilities below future grade.
- B. Prepare subgrade in accordance with requirements of Division 32.
- C. Correct subgrade deviations in excess of plus or minus 1/4 inch in cross section, or in 16-foot length by loosening, adding or removing material, reshaping and recompacting by sprinkling and rolling.
- D. Prepare sufficient subgrade in advance of base course operations.

3.3 PLACEMENT

- A. Spread and shape in lifts to compacted thickness not to exceed 6 inches in depth. Complete spreading, shaping, and compacting on same day material is deposited.

- B. Place base so that projecting reinforcing steel from curbs remain at approximate center of base. Secure a firm bond between reinforcement and base.
- C. Start rolling operations as soon as possible after placement. Use sheepfoot, steel, or pneumatic rollers as approved. Roll longitudinally with subgrade starting from sides. Overlap successive strips by one-half width of each rear wheel:
 - 1. Maintain moisture between optimum and 3 percent above optimum moisture.
- D. Compact to 95 percent of Proctor density in accordance with ASTM D 698, unless otherwise indicated on the Drawings:
 - 1. Finish to grade and compact lift before placing successive lift.
 - 2. Maintain shape by grading throughout operation.
 - 3. Provide total thickness indicated on Drawings.

3.4 TOLERANCES

- A. Completed surface shall be smooth and conform to typical section and established lines and grades.

3.5 FIELD QUALITY CONTROL

- A. Testing will be performed under provisions of Division 1.
- B. Compaction Testing will be performed in accordance with ASTM D 698 or ASTM D 2922 at a random location near each depth determination core. Rework and recompact areas that do not conform to compaction requirements.

3.6 PROTECTION

- A. Sprinkle to prevent excessive loss of moisture.
- B. Restrict construction traffic on finished base to equipment required to complete the work.

END OF SECTION

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SECTION 32 11 29.13 - LIME-FLY ASH-TREATED BASE COURSES

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Foundation course of lime/fly ash stabilized sub grade material.
 - 1. Application of lime slurry and fly ash to sub grade.
 - 2. Mixing, compaction, and curing of lime, slurry, fly ash, water, and sub grade into a stabilized foundation.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices:
 - 1. Measurement for lime stabilized subgrade, when included in the Bid Form, is on a square yard basis. Separate measurement will be made for each different required thickness of base course.
 - 2. Measurement for hydrated lime and quicklime, when included in the Bid Form, is by the ton of 2,000 pounds dry-weight basis.
 - 3. Measurement for commercial lime slurry, when included in the Bid Form, is by the ton of 2,000 pounds of lime calculated on the percentage by weight of dry solids for the grade of slurry.
- B. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for Work in this Section is included in total Stipulated Price.

1.3 DEFINITIONS

- A. Moist Cure: Curing soil lime/fly ash material to obtain optimum hydration.
- B. 1000-Foot Roadway Section: 1000 feet per lane width or approximately 500 square yards of compacted sub grade for other than full-lane-width roadway sections.

1.4 REFERENCES

- A. ASTM C 618 - Standard Specification for Coal Fly Ash and Raw or Calcinated Natural Pozzolan for use as Mineral Admixture in Portland Cement Concrete.

1.5 SUBMITTALS

- A. Conform to requirements of Division 1.
- B. Submit certification that fly ash, hydrated lime, quicklime, or commercial lime slurry complies with these specifications.
- C. Submit weight tickets, certified by supplier, with each bulk delivery of materials to work site.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Conform to requirements of Division 2.
- B. Quicklime can be dangerous; exercise extreme caution if used for Work. Become informed about recommended precautions in handling, storage and use of quicklime.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Water: clean, clear, and free from oil, acids, alkali, or vegetable matter.
- B. Conform to requirements of City of Houston Standard Specifications Section 02336 – Lime Stabilized Subgrade for Type A hydrated lime, Type C quicklime, and Type B commercial lime slurry.
- C. Fly ash: Residue or ash remaining after burning finely pulverized coal at high temperatures conforming to requirements of ASTM C 618, Type ‘C’ or ‘F’ and following:
 - 1. Minimum CaO content of 20 percent
 - 2. Loss on ignition not to exceed 3 percent
 - 3. Contain no lignite ash
- D. Asphaltic Seal Cure: Conform to requirements of Division 32.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Conform to City of Houston Standard Specifications Section 02336 – Lime Stabilized Subgrade with following exceptions:
 - 1. Include fly ash in percentage amounts in lime or lime slurry as established from geotechnical evaluation for application, mixing, and compaction.
 - 2. Apply lime/fly ash as single mix, single pass over lower PI soils.
 - 3. Conduct operations to minimize elapsed time between mixing and compacting lime/fly ash stabilized subgrade in order to take advantage of rapid initial set characteristics. Complete compaction within 2 hours of commencing compaction and not more than 6 hours after adding and mixing last stabilizing agent.

3.2 QUALITY CONTROL

- A. Testing will be performed under provisions of Division 1.
- B. Soil will be sampled to establish percent of fly ash and hydrated lime, quicklime, or lime slurry to be applied to sub grade material.
- C. Testing will be in accordance with Division 1.

END OF SECTION

SECTION 32 12 13.13 - TACK COATS

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Tack coat for asphalt concrete paving.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices:
 - 1. No separate payment will be made for tack coat under this Section. Include payment in unit price for asphaltic pavements.
 - 2. Refer to Division 1 for unit price procedures.
- B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for Work in this Section is included in total Stipulated Price.

1.3 REFERENCES

- A. ASTM D 244 - Standard Test Methods for Emulsified Asphalts.

1.4 SUBMITTALS

- A. Conform to requirements of Division 1.
- B. Submit product data for proposed tack coat.
- C. Submit report of recent calibration of distributor.

PART 2 PRODUCTS

2.1 EMULSION

- A. Provide homogeneous material which shows no separation of asphalt after mixing and meets viscosity requirements within 30 days after delivery.
- B. Emulsion material for tack coat:
 - 1. Emulsified asphalt: SS-1 or SS-1h meeting following criteria:

| PROPERTIES | SS-1 | | SS-1h | |
|------------------------------------|---------|------|-------|------|
| | MIN. | MAX. | MIN. | MAX. |
| Furol Viscosity at 77°F, sec. | 20 | 100 | 20 | 100 |
| Residue by Distillation, % | 60 | -- | 60 | -- |
| Oil Portion of Distillate, % | -- | ½ | -- | ½ |
| Sieve Test, % | -- | 0.10 | -- | 0.10 |
| Miscibility (Standard Test) | Passing | | | |
| Cement Mixing, % | -- | 2.0 | -- | 2.0 |
| Storage Stability, 1 Day, % | -- | 1 | -- | 1 |
| Test on Residue: | | | | |
| Penetration at 77°F, 100g, 5 sec. | 120 | 160 | 70 | 100 |
| Solubility in Trichloroethylene, % | 97.5 | -- | 97.5 | -- |
| Ductility at 77°F, 5 cm/min., cms | 100 | -- | 80 | -- |

2. Polymer Modified Emulsion, SS-1P, for use where thin overlays (less than or equal 2 inches) are placed on collector or arterial streets and for speed humps, especially over existing Portland cement concrete pavement.

| PROPERTIES | SS-1P | |
|------------------------------------|---------|------|
| | MIN. | MAX. |
| Furol Viscosity at 77°F, sec. | 30 | 100 |
| Residue by Distillation, % | 60 | -- |
| Oil Portion of Distillate, % | -- | ½ |
| Sieve Test, % | -- | 0.10 |
| Miscibility (Standard Test) | Passing | |
| Cement Mixing, % | -- | 2.0 |
| Storage Stability, 1 Day, % | -- | 1 |
| Test on Residue: | | |
| Penetration at 77°F, 100g, 5 sec.; | 100 | 140 |
| Solubility in Trichloroethylene, % | 97 | -- |
| Ductility at 77°F, 5 cm/min., cms; | 50 | -- |
| Viscosity at 140°F, poises | 1300 | -- |

3. For emulsions used for tack coats during period of April 16 through September 15, volatile organic compound solvents (VOC) shall not exceed 12 percent by weight when tested in accordance with ASTM D 244.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify compacted base is ready to support imposed loads.
- B. Verify lines and grades are correct.

3.2 PREPARATION

- A. Thoroughly clean base course or concrete surface of loose material by brooming prior to tack coat application.

3.3 APPLICATION

- A. Apply tack coat uniformly by use of approved distributor at rate not to exceed 0.05 gallons per square yard of surface depending on texture of underlying surface. Select an application rate that will provide appropriate asphalt residual.
- B. Paint contact surfaces of curbs, structures, and joints with thin uniform coat of tack coat.

3.4 PROTECTION

- A. Prevent traffic or placement of subsequent courses over freshly applied tack coat until authorized by Owner's Representative.

END OF SECTION

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SECTION 32 12 13.19 - PRIME COATS

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Prime coat for asphalt concrete paving

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices:
 - 1. No separate payment will be made for prime coat under this Section. Include payment in unit price for material being primed.
 - 2. Refer to Division 1 for unit price procedures.
- B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for Work in this Section is included in total Stipulated Price.

1.3 SUBMITTALS

- A. Conform to requirements of Division 1.
- B. Submit product data for proposed prime coat.
- C. Submit report of recent calibration of distributor.

PART 2 PRODUCTS

2.1 CUTBACK ASPHALT

- A. Provide moisture-free homogeneous material which will not foam when heated to 347 degrees F and which meets following requirements:
- B. Asphalt material for prime coat shall be MC-30 or MC-70 and shall meet following requirements:

| PROPERTIES | TYPE – GRADE | | | |
|----------------------------------|--------------|------|-------|------|
| | MC-30 | | MC-70 | |
| | MIN. | MAX. | MIN. | MAX. |
| Water, Percent | -- | 0.2 | --- | 0.2 |
| Flash Point, T.O.C., °F | 100 | -- | 100 | -- |
| Kinematic Viscosity at 140°, cst | | | | |

- 1. Distillate shall be as follows, expressed as percent by volume of total distillate to 680 degrees F:

| TEMPERATURE | TYPE – GRADE | | | |
|--|--------------|------|-------|------|
| | MC-30 | | MC-70 | |
| | MIN. | MAX. | MIN. | MAX. |
| To 437°F | -- | 2.5 | --- | 20 |
| To 500°F | 40 | 70 | 20 | 60 |
| To 600°F | 75 | 93 | 65 | 90 |
| Residue from 690°F Distillation, Volume, Percent | | | | |

2. Tests on Distillation Residue:

| TEST | TYPE – GRADE | | | |
|------------------------------------|--------------|------|-------|------|
| | MC-30 | | MC-70 | |
| | MIN. | MAX. | MIN. | MAX. |
| Penetration at 77°R, 100g, 5 sec. | 120 | 250 | 120 | 250 |
| Ductility at 77°F, 5 cm/min. cms | 100* | -- | 100* | -- |
| Solubility in Trichloroethylene, % | 99 | -- | 99 | -- |
| Spot Test | All Negative | | | |

* If penetration of residue is more than 200 and ductility at 77 degrees F is less than 100 cm, material will be acceptable when its ductility at 60 degrees F is more than 100.

2.2 EMULSIFIED PETROLEUM RESIN

A. EPR-1 Prime: Slow curing emulsion of petroleum resin and asphalt cement conforming to following requirements:

| PROPERTIES | MIN. | MAX. |
|-------------------------------------|----------|------|
| Fural viscosity at 77°F, Sec. | 14 | 40 |
| Residue by Evaporation, % by Weight | 60 | -- |
| Sieve Test, % | -- | 0.1 |
| Particle Charge Test | Positive | |
| Tests on Distillation Residue: | | |
| Flash Point, COC (F) | 400 | -- |
| Kinematic Viscosity @ 140 F (cst) | 190 | 350 |

B. For use, EPR-1 may be diluted with water up to maximum three parts water to one part EPR-1 in order to achieve desired concentration of residual resin/asphalt to facilitate application.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify base is ready to support imposed loads.
- B. Verify lines and grades are correct.

3.2 PREPARATION

- A. Thoroughly clean base course surface of loose material by brooming prior to application of tack coat.

- B. Prepare sufficient base in advance of paving for efficient operations.

3.3 APPLICATION, BASIC

- A. Apply prime coat with approved type of self-propelled pressure distributor. Distribute prime coat evenly and smoothly under pressure necessary for proper distribution.
- B. Keep storage tanks, piping, retorts, booster tanks, and distributors used in handling asphalt materials clean and in good operating condition. Conduct operations so asphalt material does not become contaminated.
- C. If yield of asphaltic material appears to be in error, recalibrate distributor prior to continuing Work.
- D. Maintain surface until Work is accepted by City and/or Owner.

3.4 APPLICATION, CUTBACK ASPHALT

- A. Do not use cutback asphalt during period of April 16 through September 15.
- B. Do not place prime coat when air temperature is below 60 degrees F and falling. Materials may be placed when air temperature taken in shade and away from artificial heat is above 50 degrees F and rising.
- C. Distribute at rate of 0.25 to 0.35 gallons per square yard.
- D. Equipment shall accurately determine temperature of asphaltic material in heating equipment and in distributor, for determining rate of application, and for obtaining uniformity at junction of two distributor loads. Maintain in accurate working order, including recording thermometer at storage heating unit.
- E. Base temperature of application on temperature-viscosity relationship that will permit application of asphalt with viscosity of 100 to 125 centistokes. Maintain asphalt within 15 degrees F of temperature required to meet viscosity. Selected temperature shall be within following range.

| <u>Prime Coat Type</u> | <u>Minimum (°F)</u> | <u>Maximum (°F)</u> |
|------------------------|---------------------|---------------------|
| MC-30 | 70 | 150 |
| MC-70 | 125 | 175 |

- F. Do not allow temperature of MC-30 to exceed 175 degrees F.
- G. Do not allow temperature of MC-70 to exceed 200 degrees F.

3.5 APPLICATION, EMULSIFIED PETROLEUM RESIN

- A. Do not place prime coat when air temperature is below 36 degrees F and falling.
- B. Distribute at rate of 0.15 to 0.25 gallons per square yard.

3.6 PROTECTION

- A. Prevent traffic or placement of subsequent courses over freshly applied prime coat until authorized by Owner's Representative.

END OF SECTION

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SECTION 32 12 16 - ASPHALT PAVING

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Surface course of compacted mixture of coarse and fine aggregates and asphaltic binder.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices:
 - 1. Payment for hot-mix asphalt concrete pavement is on a per square yard basis. Separate pay items are used for each different required thickness of pavement.
 - 2. Payment for hot-mix asphalt concrete pavement includes payment for associated work performed in accordance with Division 1.
 - 3. Measurement for utility projects: Match actual pavement replaced but no greater than maximum pavement replacement limits shown on Drawings.
 - 4. Payment for temporary detour pavement is on a square yard basis and includes surface and base materials, associated grading, maintenance, and removal as well as restoration of ditches.
 - 5. Payment for speed humps is on linear foot basis, and includes milling of existing pavement, tack coat, and placement and compaction of asphalt. Measurement of speed hump is along length of 12 foot wide speed hump, measured transverse to centerline of road. Separate payment is made for thermoplastic markings applied to speed hump.
 - 6. Refer to Division 1 for unit price procedures.
- B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 REFERENCES

- A. ASTM C 33 - Standard Specification for Concrete Aggregates.
- B. ASTM C 131 - Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
- C. TxDOT Tex-106-E - Calculating the Plasticity Index of Soils
- D. TxDOT Tex-126-E - Molding, Testing, and Evaluating Bituminous Black Base Material.
- E. TxDOT Tex-200-F - Sieve Analysis of Fine and Course Aggregates.
- F. TxDOT Tex-203-F - Sand Equivalent Test.
- G. TxDOT Tex-204-F - Design of Bituminous Mixtures.
- H. TxDOT Tex 206-F - Compacting Test Specimens of Bituminous Mixtures.
- I. TxDOT Tex-207-F - Determining Density of Compacted Bituminous Mixtures.
- J. TxDOT Tex-208-F - Test for Stabilometer Value of Bituminous Mixtures.

- K. TxDOT Tex-217-F - Determining Deleterious Material and Decantation Test for Coarse Aggregates.
- L. TxDOT Tex-227-F - Theoretical Maximum Specific Gravity of Bituminous Mixtures.
- M. TxDOT Tex-530-C - Effect of Water on Bituminous Paving Mixtures.
- N. TxDOT Tex-531-C - Prediction of Moisture Induced Damage to Bituminous Paving Materials Using Molded Specimens.

1.4 SUBMITTALS

- A. Conform to requirements of Division 1.
- B. Submit certificates that asphalt materials and aggregates meet requirements of Paragraph 2.01, Materials.
- C. Submit proposed design mix and test data for surface course.
- D. Submit manufacturer's description and characteristics of spreading and finishing machine for approval.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Coarse Aggregate:
 - 1. Use gravel, crushed stone, or combination thereof, that is retained on No. 10 sieve, uniform in quality throughout and free from dirt, organic or other injurious matter occurring either free or as coating on aggregate. Use aggregate conforming to ASTM C 33 except for gradation. Furnish rock or gravel with Los Angeles abrasion loss not to exceed 40 percent by weight when tested in accordance with ASTM C 131.
 - 2. Aggregate by weight shall not contain more than 1.0 percent by weight of fine dust, clay-like particles, or silt when tested in accordance with Tex-217-F, Part II.
- B. Fine Aggregate: Sand, stone screenings, or combination of both passing No. 10 sieve. Use aggregate conforming to ASTM C 33 except for gradation. Use sand composed of sound, durable stone particles free from loams or other injurious foreign matter. Furnish screenings of same or similar material as specified for coarse aggregate. Plasticity index of that part of fine aggregate passing No. 40 sieve shall be not more than 6 when tested by TxDOT Tex-106-E. Sand equivalent shall have minimum value of 45 when tested by TxDOT Tex-203-F.

- C. Composite Aggregate: Conform to following limits when graded in accordance with TxDOT Tex-200-F. Use type specified on Drawings:

| GRADATION OF COMPOSITE AGGREGATE | | |
|---|--|---|
| SIEVE SIZE | PERCENT PASSING | |
| | Course Surface (TxDOT Type C) | Fine Surface (TxDOT) Type D) |
| 7/8" | 100 | --- |
| 5/8" | 95 to 100 | --- |
| 1/2" | --- | 100 |
| 3/8" | 70 to 85 | 85 to 100 |
| #4 | 43 to 63 | 50 to 70 |
| #10 | 30 to 40 | 32 to 42 |
| #40 | 10 to 25 | 11 to 26 |
| #80 | 3 to 13 | 4 to 14 |
| #200 | 1 to 6* | 1 to 6* |
| VMA % minimum | 13 | 14 |
| *2 to 8 when Test Method Tex-200-F, Part I (Washed Sieve Analysis) is used. | | |

- D. Asphalt Binder: Moisture-free homogeneous material which will not foam when heated to 347 F, meeting the following requirements.

| PERFORMANCE GRADED BINDER | |
|---|-----------------------------|
| CRITERIA / TEST | PERFORMANCE GRADE (PG64-22) |
| Average 7-day Maximum Pavement Design Temperature, C | < 64 |
| Minimum Pavement Design Temperature, C | > -22 |
| ORIGINAL BINDER | |
| Flash Point Temperature, T48; Minimum C | 230 |
| Viscosity, ASTM D 4402; Maximum, 3 Pa*s (3000 cP) Test Temperature, C | 135 |
| Dynamic Shear, TP5; G*/sin [], Minimum, 1.00 kPa Test Temperature @ 10 rad/sec., C | 64 |
| ROLLING THIN FILM OVEN (T240) OR THIN FILM OVEN (T179) RESIDUE | |
| Mass Loss, Maximum, % | 1.00 |
| Dynamic Shear, TP5; G*/sin [], Minimum, 2.20kPa Test Temperature @10 rad/sec., C | 64 |
| PRESSURE AGING VESSEL RESIDUE (PP1) | |
| PAV Aging Temperature, C | 100 |
| Dynamic Shear, TP5; G*/sin [], Minimum, 5000 kPa Test Temperature @10 rad/sec., C | 25 |
| Physical hardening | Report |
| Creep Stiffness, TP1; S, Maximum, 300 Mpa—value, Minimum 0.300 Test Temperature @ 60 sec., C | -12 |
| Direct Tension, TP3; Failure Strain, Minimum, 1.0% Test Temperature @ 1.0 mm/min, C | -12 |

- E. Anti-stripping Agent:
1. Evaluate mixture of aggregate, asphalt, and additives proposed for use for moisture susceptibility and requirement for anti-stripping agents. To substantiate mix design, produce and test trial mixtures using proposed project materials and equipment prior to placement. Test for susceptibility to moisture and trial mixture may be waived by Owner's Representative when similar designs using same material have previously proven satisfactory.
 2. Liquid Anti-stripping Agent. Use anti-stripping agent with uniform liquid with no evidence of crystallization, settling, or separation of components. Submit sample of anti-stripping agent proposed for use and manufacturer's product data, including recommended dosage range, handling and storage, and application instructions.
- F. Pavement markings for speed humps: Conform to requirements of Division 32.

2.2 EQUIPMENT

- A. Mixing Plant: Weight-batching or drum mix plant with capacity for producing continuous mixtures meeting specifications. With exception of a drum mix plant, plant shall have satisfactory conveyors, power units, aggregate handling equipment, hot aggregate screens and bins, and dust collectors.
- B. Provide equipment to supply materials adequately in accordance with rated capacity of plant and produce finished material within specified tolerances. Following equipment is essential:
 - 1. Cold aggregate bins and proportioning device
 - 2. Dryer
 - 3. Screens
 - 4. Aggregate weight box and batching scales
 - 5. Mixer
 - 6. Asphalt storage and heating devices
 - 7. Asphalt measuring devices
 - 8. Truck scales
- C. Bins: Separate aggregate into minimum of four bins to produce consistently uniform grading and asphalt content in completed mix. Provide one cold feed bin per stockpile.

2.3 MIXES

- A. Employ certified testing laboratory to prepare design mixes. Test in accordance with TxDOT Tex-126-E or Tex-204-F, Tex-206-F, Tex-208-F, Tex-530-C and Tex-531-C.
- B. Density, Stability and Air Void Requirements:

| Percent Density | | Percent | HVEEM Stability |
|-----------------|-------------|----------------|----------------------|
| <u>Min.</u> | <u>Max.</u> | <u>Optimum</u> | <u>Not Less Than</u> |
| 94.5 | 97.5 | 96 | 35 |

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify compacted base course is ready to support imposed loads.
- B. Verify lines and grades are correct.

3.2 PREPARATION

- A. Tack Coat: Conform to requirements of Division 32. Where mixture will adhere to surface on which it is to be placed without use of tack coat, tack coat may be eliminated when approved by Owner's Representative.
- B. Prepare subgrade in accordance with requirements of Division 32.
- C. Prepare subgrade in advance of asphalt concrete paving operation.
- D. Perform pavement repair and resurfacing as indicated in Division 32.
- E. Do not use cutback asphalt.

- F. Milling of pavement for speed humps: Mill pavement (concrete or asphalt) to depth of one inch and width between 18 and 24 inches around entire perimeter of proposed hump, as shown in detail for speed hump design.

3.3 PLACEMENT

- A. Do not place asphalt pavement less than 2 inches thick when surface temperature taken in shade and away from artificial heat is below 50 F and falling. Asphalt may be placed when temperature is above 40 F and rising.
- B. Haul prepared and heated asphaltic concrete mixture to project in tight vehicles previously cleaned of foreign material. Mixture temperature shall be between 250 F and 325 F when laid.
- C. Spread material into place with approved mechanical spreading and finishing machine of screening or tamping type.
- D. Surface Course Material: Surface course 2 inches or less in thickness may be spread in one lift. Spread lifts in such a manner that, when compacted, finished course will be smooth, of uniform density, and will be to section, line and grade as shown. Place construction joints on surface courses to coincide with lane lines or as directed by Owner's Representative.
- E. Joints: Pass roller over unprotected ends of freshly laid mixture only when mixture has cooled. When work is resumed, cut back laid material to produce slightly beveled edge for full thickness of course. Remove old material which has been cut away and lay new mix against fresh cut.
- F. When new asphalt is laid against existing or old asphalt, saw cut existing or old asphalt to full depth to provide straight smooth joint.
- G. In smaller restricted areas where use of paver is impractical spread material by hand. Compact asphalt by mechanical means. Carefully place materials to avoid segregation of mix. Do not broadcast material. Remove lumps that do not break down readily.

3.4 COMPACTION

- A. Construct test strip to identify correct type, number, and sequence of rollers necessary to obtain specified in-place density or air-voids when directed by the Owner's Representative. Prepare test strip at least 1,000 feet in length, comparable to placement and compaction conditions for Project.
- B. Begin rolling while pavement is still hot and as soon as it will bear roller without shoving, displacement or hair cracking. Keep wheels properly moistened with water to prevent adhesion of surface mixture. Do not use excessive water or petroleum by-products.
- C. Compact surface thoroughly and uniformly, first with power-driven, 3-wheel, or tandem rollers weighing a minimum of 8 tons. Obtain subsequent compression by starting at side and rolling longitudinally toward center of pavement, overlapping on successive trips by at least one-half width of rear wheels. Make alternate trips slightly different in length. Continue rolling until no further compression can be obtained and rolling marks are eliminated. Complete rolling before mat temperature drops below 185 F.
- D. Use tandem roller for final rolling. Double coverage with approved pneumatic roller on asphaltic concrete surface is acceptable after flat wheel and tandem rolling has been completed.

- E. Along walls, curbs, headers and similar structures, and in locations not accessible to rollers, compact mixture thoroughly with lightly oiled tamps.
- F. Compact binder course and surface course to a minimum density of 91 percent of maximum possible density of voidless mixture composed of same materials in like proportions.

3.5 TOLERANCES

- A. Furnish templates for checking surface in finished sections. Maximum deflection of templates, when supported at center, shall not exceed 1/8 inch.
- B. Completed surface, when tested with 10-foot straightedge laid parallel to center line of pavement, shall show no deviation in excess of 1/8 inch in 10 feet. Correct surface not meeting this requirement.
- C. Dimensions of speed humps shall conform to details for speed hump design and speed hump height tolerances.

3.6 QUALITY CONTROL

- A. Testing will be performed under provisions of Division 1.
- B. For in-place depth and density, take minimum of one core at random locations for each 1000 feet of single lane pavement. On a 2-lane pavement, take samples at random every 500 feet from alternating lanes. Take cores for parking lots every 500 square yards of base to determine in-place depth and density. If cul-de sac or streets are less than 500 feet, minimum of 2 cores (one per lane) will be procured. On small projects, take a minimum of two cores for each day's placement. For first days placement and prior to coring, minimum of 5 nuclear gauge readings will be performed at each core location to establish correlation between nuclear gauge (wet density reading) and core (bulk density). This process will continue for each day's placement until engineer determines that a good bias has been established for that nuclear gauge.
- C. Determine in-place density in accordance with TxDOT Tex-207-F and Tex-227-F from cores or sections. Other methods of determining in-place density, which correlate satisfactorily with results obtained from roadway specimens, may be used when approved by Owner's Representative. Average densities for each street placed in a single day to determine compliance.
- D. Contractor may request three additional cores in vicinity of cores indicating nonconforming in-place depths or density at no additional cost to Owner. In-place depth and density at these locations shall be average of four cores.
- E. Fill cores and density test sections with new compacted asphaltic concrete.
- F. Speed humps: Measure dimensions of completed speed hump, before applying pavement markings, at locations shown on Speed Hump Height Measurement Worksheet. Complete one worksheet for each speed hump and send completed worksheets to city or county.

3.7 NONCONFORMING PAVEMENT

- A. Recompact and retest nonconforming street sections not meeting surface test requirements or having unacceptable surface texture. Patch asphalt pavement sections in accordance with procedures established by Asphalt Institute. Retesting is at no cost to the Owner.

- B. Remove and replace areas of asphalt surface found deficient in thickness by more than 10 percent. Use new asphaltic surface of thickness shown on Drawings. Remove and replace areas of asphalt surface found deficient in average density.
- C. Replace speed humps which do not conform to requirements of details, or which are rejected by Owner's Representative.

3.8 PROTECTION

- A. Do not open pavement to traffic until completion of rolling and temperature has cooled to set asphaltic concrete surface, or as shown on Drawings.
- B. Maintain asphalt pavement in good condition until completion of Work.
- C. Repair defects immediately by replacing asphalt pavement to full depth.

3.9 PAVEMENT MARKINGS FOR SPEED HUMPS

- A. Apply pavement markings to speed humps in conformance with dimensions shown on detail for speed hump design.

END OF SECTION

SECTION 32 1313

CONCRETE PAVING

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Portland cement concrete paving.

1.02 MEASUREMENT AND PAYMENT

- A. Unit Prices:
 - 1. Payment for concrete paving will be on a square yard basis.
- B. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for Work in this Section is included in total Stipulated Price.

1.03 REFERENCES

- A. ASTM A 82 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
- B. ASTM A 185 - Standard Specifications for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.
- C. ASTM A 615 - Standard Specification for Deformed and Plain Billet - Steel Bars for Concrete Reinforcement.
- D. ASTM C 31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
- E. ASTM C 33 - Standard Specifications for Concrete Aggregates.
- F. ASTM C 39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
- G. ASTM C 40 - Standard Test Method for Organic Impurities in Fine Aggregates for Concrete.
- H. ASTM C 42 - Standard Test Method of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
- I. ASTM C 78 - Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third Point Loading).
- J. ASTM C 94 - Standard Specification for Ready-Mixed Concrete.
- K. ASTM C 131 - Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
- L. ASTM C 136 - Standard Method for Sieve Analysis of Fine and Coarse Aggregates.
- M. ASTM C 138 - Standard Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete.

- N. ASTM C 143 - Standard Test Method for Slump of Hydraulic Cement Concrete.
- O. ASTM C 150 - Standard Specification for Portland Cement.
- P. ASTM C 174 - Standard Test Method for Measuring Thickness of Concrete Elements Using Drilled Concrete Cores.
- Q. ASTM C 231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
- R. ASTM C 260 - Standard Specification for Air-Entraining Admixtures for Concrete.
- S. ASTM C 494 - Standard Specification for Chemical Admixtures for Concrete.
- T. ASTM C 618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for use as a Mineral Admixture in Portland Cement Concrete.
- U. TxDOT Tex-203-F - Sand Equivalent Test.
- V. TxDOT Tex-406-A - Material Finer than 75 Fm (No. 200) Sieve In Mineral Aggregates (Decantation Test for Cement Aggregates).

1.04 SUBMITTALS

- A. Conform to requirements of Division 1.
- B. Submit proposed mix design and test data for each type and strength of concrete in Work. Include proportions and actual flexural strength obtained from design mixes at required test ages.
- C. Submit for approval manufacturer's description and characteristics for mixing equipment, and for traveling form paver, when proposed for use.
- D. Submit manufacturer's certificates giving properties of reinforcing steel. Include certificate of compliance with ASTM A 82. Provide specimens for testing when required by Owner's Representative.
- E. CHPS Submittals:
 - 1. Product Data for Credit ME 4.1: For structural steel products (including reinforcing steel), documentation indicating percentages by weight of post-consumer recycled content. Project requirement is a minimum 67% post-consumer recycled content for all structural steel.

1.05 HANDLING AND STORAGE

- A. Do not mix different classes of aggregate without written permission of Owner's Representative.
- B. Class of aggregate being used may be changed before or during Work with written permission of Owner's Representative. Comply new class with specifications.
- C. Reject segregated aggregate. Before using aggregate, whose particles are separated by size, mix them uniformly to grading requirements.

- D. Reject aggregates mixed with dirt, weeds, or foreign matter.
- E. Do not dump or store aggregate in roadbed.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Portland Cement:
 - 1. Sample and test cement to verify compliance with Standards of ASTM C 150, Type I or Type III.
 - 2. Bulk cement which meets referenced standards may be used when method of handling is approved by Owner's Representative. When using bulk cement, provide satisfactory weighing devices.
 - 3. Fly ash which meets standards of ASTM C 618 may be used as mineral fill when method of handling is approved by Owner's Representative.

B. Water: Conform to requirements for water in ASTM C 94.

C. Coarse Aggregate: Crushed stone, gravel, or combination thereof, which is clean, hard, and durable, conforms to requirements of ASTM C 33, and has abrasion loss not more than 45 percent by weight when subjected to Los Angeles Abrasion Test (ASTM C 131).

- 1. Maximum percentage by weight of deleterious substances shall not exceed following values:

| <u>Item</u> | <u>Percent by Weight of Total Sample Maximum</u> |
|---|--|
| Clay lumps and friable particles | 3.0 |
| Material finer than 75-um (No. 200) sieve: | |
| Concrete subject to abrasion | 3.0* |
| All other concrete | 5.0* |
| Coal and lignite: | |
| Where surface appearance of concrete is of importance | 0.5 |
| All other concrete | 1.0 |

* In case of manufactured sand, when material finer than 75-µm (No. 200) sieve consists of dust of fracture, essentially free from clay or shale, these limits may be increased to 5 and 7 percent, respectively.

- 2. Conform coarse aggregate (size 1 1/2 inch to No. 4 sieve) to requirements of ASTM C 33. Use gradation within following limits when graded in accordance with ASTM C 136:

| <u>Sieve Designation (Square Openings)</u> | <u>Percentage by Weight</u> |
|---|-----------------------------|
| Retained on 1 3/4" sieve | 0 |
| Retained on 1 1/2" sieve | 0 to 5 |
| Retained on 3/4" sieve | 30 to 65 |
| Retained on 3/8" sieve | 70 to 90 |
| Retained on No. 4 sieve | 95 to 100 |
| Loss by Decantation Test *Method Tex-406-A | 1.0 maximum |

* In case of aggregates made primarily from crushing of stone, when material finer than 200 sieve is dust of fracture essentially free from clay or shale as established by Part III of TxDOT Tex-406-A, percent may be increased to 1.5.

- D. Fine Aggregate: Sand, manufactured sand, or combination thereof, composed of clean, hard, durable, uncoated grains, free from loams or other injurious foreign matter. Conform fine aggregate for concrete to requirements of ASTM C 33. Use gradation within following limits when graded in accordance with ASTM C 136:

| <u>Sieve Designation (Square Openings)</u> | <u>Percentage by Weight</u> |
|--|-----------------------------|
| Retained on 3/8" sieve | 0 |
| Retained on No. 4 sieve | 0 to 5 |
| Retained on No. 8 sieve | 0 to 20 |
| Retained on No. 16 sieve | 15 to 50 |
| Retained on No. 30 sieve | 35 to 75 |
| Retained on No. 50 sieve | 65 to 90 |
| Retained on No. 100 sieve | 90 to 100 |
| Retained on No. 200 sieve | 97 to 100 |

1. When subjected to color test for organic impurities (ASTM C 40), fine aggregate shall not show color darker than standard color. Fine aggregate shall be subjected to Sand Equivalent Test (Tex-203-F). Sand equivalent value shall not be less than 80 unless higher value is shown on Drawings.
- E. Mineral Filler: Type "C" or Type "F" fly ash of acceptable quality and meeting requirements of ASTM C 618 may be used as mineral admixture in concrete mixture as approved by the Engineer. When fly ash mineral filler is used, store and inspect in accordance with ASTM C 618. Do not use fly ash in amounts to exceed 25 percent by weight of cementitious material in mix design. Cement content may be reduced when strength requirements can be met. Note: When fly ash is used, term "cement" is defined as cement plus fly ash.
- F. Air Entraining Agent: Furnish air entraining agent conforming to requirements of ASTM C 260.
- G. Water Reducer: Water reducing admixture conforming to requirements of ASTM C 494 may be used when required to improve workability of concrete. Amount and type of admixture is subject to approval by Owner's Representative.
- H. Reinforcing Steel:
1. Provide new billet steel manufactured by open hearth process and conforming to ASTM A 615, Grade 60. Store steel to protect it from mechanical injury and rust. At time of placement, steel shall be free from dirt, scale, rust, paint, oil, or other injurious materials.
 2. Cold bend reinforcing steel to shapes shown. Once steel has been bent, it may not be rebent.
 3. Provide wire fabric conforming to ASTM A 82. Use fabric in which longitudinal and transverse wires have been electrically welded at points of intersection. Welds shall have sufficient strength not to be broken during handling or placing. Conform welding and fabrication of fabric sheets to ASTM A 185.

2.02 EQUIPMENT

- A. Conform Equipment to requirements of ASTM C 94.

2.03 MIXING

- A. Flexural strength shall be as specified using test specimens prepared in accordance with ASTM C 31 and tested in accordance with ASTM C78 (using simple beam with third-point loading). Compressive strength shall be as specified using test specimens prepared in accordance with ASTM C 31 and tested in accordance with ASTM C 39. Determine and measure batch quantity of each ingredient, including water for batch designs and all concrete produced for Work. Mix shall conform to these specifications and other requirements indicated on Drawings.
- B. Mix design to produce concrete which will have minimum compressive strength of 3,000 psi at 7 days and 3,500 psi at 28 days. Slump of concrete shall be at least 2 inches but no more than 6 inches, when tested in accordance with ASTM C 143.
 - 1. Concrete pavement coordinate with curb and gutter spec section 32 16 13, including curb, curb and gutter, and saw-tooth curb, shall contain at least 5 1/2 sacks (94 pounds per sack) of cement per cubic yard, with not more than 6.5 gallons of water, net, per sack of cement (water-cement ratio maximum 0.57). Determine cement content in accordance with ASTM C 138. Addition of mineral filler may be used to improve workability or plasticity of concrete to limits specified.
 - 2. Coarse dry aggregate shall not exceed 85 percent of loose volume of concrete.
 - 3. Add air-entraining admixture to ensure uniform distribution of agent throughout batch. Base air content of freshly mixed air-entrained concrete upon trial mixes with materials to be used in Work, adjusted to produce concrete of required plasticity and workability. Percentage of air entrainment in mix shall be 4 1/2 percent plus or minus 1 1/2 percent. Determine air content by testing in accordance with ASTM C 231.
 - 4. Use retardant when temperature exceeds 90 degrees F. Proportion as recommended by manufacturer. Use same brand as used for air-entraining agent. Add and batch material using same methods as used for air-entraining agent.
- C. Use high early strength concrete pavement to limits shown on Drawings. Design to meet following:
 - 1. Concrete Mix: Flexural strength greater than or equal to 500 psi at 72 hours.
 - 2. Cement: Minimum of 7 sacks of cement per cubic yard of concrete.
 - 3. Water-Cement Ratio maximum of 0.45. Slump of concrete shall a maximum of 5 inches, when tested in accordance with ASTM C 143.
 - 4. Other requirements for proportioning, mixing, execution, testing, etc., shall be in accordance with this Division 32.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify compacted base is ready to support imposed loads and meets compaction requirements.
- B. Verify lines and grades are correct.

3.02 PREPARATION

- A. Properly prepare, shape, and compact each section of subgrade before placing forms, reinforcing steel or concrete. After forms have been set to proper grade and alignment, use subgrade planer to shape subgrade to its final cross section. Check contour of subgrade with template.
- B. Remove subgrade that will not support loaded form. Replace and compact subgrade to required density.

3.03 EQUIPMENT

- A. Alternate equipment and methods, other than those required by this Section, may be used provided equal or better results will be obtained. Maintain equipment for preparing subgrade and for finishing and compacting concrete in good working order.
- B. Subgrade Planer and Template:
 - 1. Use subgrade planer with adjustable cutting blades to trim subgrade to exact section shown on Drawings. Select planer mounted on visible rollers which ride on forms. Planer frame must have sufficient weight so that it will remain on form, and have strength and rigidity that, under tests made by changing support from wheels to center, planer will not develop deflection of more than 1/8 inch. Tractors used to pull planer shall not produce ruts or indentations in subgrade. When slip form method of paving is used, operate subgrade planer on prepared track grade or have it controlled by electronic sensor system operated from string line to establish horizontal alignment and elevation of subbase.
 - 2. Provide template for checking contour of subgrade. Template shall be long enough to rest upon side forms and have strength and rigidity that, when supported at center, maximum deflection shall not exceed 1/8 inch. Fit template with accurately adjustable rods projecting downward at 1 foot intervals. Adjust these rods to gauge cross sections of slab bottom when template is resting on side forms.
- C. Machine Finisher: Provide power-driven, transverse finishing machine designed and operated to strike off and consolidate concrete. Machine shall have two screeds accurately adjusted to crown of pavement and with frame equipped to ride on forms. Use finishing machine with rubber tires when it operates on concrete pavement.
- D. Hand Finishing:
 - 1. Provide mechanical strike and tamping template 2 feet longer than width of pavement to be finished. Shape template to pavement section.
 - 2. Provide two bridges to ride on forms and span pavement for finishing expansion and dummy joints. Provide floats and necessary edging and finishing tools.
- E. Burlap Drag or transverse broom for Finishing Slab: Furnish four plies of 10 ounce burlap material fastened to bridge to form continuous strip of burlap full width of pavement. Maintain contact 3 foot width of burlap material with pavement surface. Keep burlap drags clean and free of encrusted mortar.
- F. Vibrators: Furnish mechanically-operated, synchronized vibrators mounted on tamping bar which rides on forms and hand-manipulated mechanical vibrators. Furnish vibrators with frequency of vibration to provide maximum consolidation of concrete without segregation.
- G. Traveling Form Paver: Approved traveling form paver may be used in lieu of construction methods employing forms, consolidating, finishing, and floating equipment. Meet requirements of this specification for subgrade, pavement tolerances, pavement depth, alignments, consolidation, finishing and workmanship. When traveling form paver does not

provide concrete paving that meets compaction, finish, and tolerance requirements of this Specification, immediately discontinue its use, and use conventional methods.

1. Equip traveling paver with longitudinal transangular finishing float adjustable to crown and grade. Use float long enough to extend across pavement to side forms or edge of slab.
2. Ensure that continuous deposit of concrete can be made at paver to minimize starting and stopping. Use conventional means of paving locations inaccessible to traveling paver or having horizontal or vertical curvature that traveling paver cannot negotiate.
3. Where Drawings require tie bars for adjacent paving, securely tie and support bars to prevent displacement. Tie bars may be installed with approved mechanical bar inserter mounted on traveling-form paver. Replace pavement in which tie bars assume final position other than that shown on Drawings.

3.04 FORMS

- A. Side Forms: Use forms of approved shape and section. Form depth shall be equal to required edge thickness of pavement. Forms with depths greater or than required edge thickness of pavement will be permitted, provided difference between form depth and edge thickness when not greater than 1 inch. Length of form sections shall be not less than 10 feet and each section shall provide for staking in position with not less than 3 pins. Flexible or curved forms of wood or metal of proper radius shall be used for curves of 200 foot radius or less. Forms shall have ample strength and shall be provided with adequate devices for secure setting so that when in-place they will withstand, without visible springing or settlement, impact and vibration of finishing machine. Forms shall be free from warp, bends or kinks and shall be sufficiently true to provide straight edge on concrete. Top of each form section, when tested with straight edge, shall conform to requirements specified for surface of completed pavement. Provide sufficient forms for satisfactory placement of concrete. For short radius curves, forms less than 10 feet in length or curved forms may be used.
- B. Form Setting:
 1. Rest forms directly on subgrade. Do not shim with pebbles or dirt. Accurately set forms to required grade and alignment and, during entire operation of placing, compacting, and finishing of concrete, do not deviate from this grade and alignment more than 1/8 inch in 10 feet of length. Do not remove forms for at least 8 hours after completion of finishing operations. Provide supply of forms that will be adequate for orderly and continuous placing of concrete. Set forms and check grade for at least 300 feet ahead of mixer or as approved by Owner's Representative.
 2. Adjacent slabs may be used instead of forms, provided that concrete is well protected from possible damage by finishing equipment. Do not use adjacent slabs for forms until concrete has aged at least 7 days.

3.05 REINFORCING STEEL AND JOINT ASSEMBLIES

- A. Place reinforcing steel and joint assemblies and position securely as indicated on Drawings. Wire reinforcing bars securely together at intersections and splices. Bars and coatings shall be free of rust, dirt or other foreign matter when concrete is placed. Secure reinforcing steel to chairs.
- B. Position pavement joint assemblies at required locations and elevations, and rigidly secure in position. Install dowel bars in joint assemblies, each parallel to pavement surface and to center line of pavement, as shown.
- C. Cut header boards, joint filler, and other material used for forming joints to receive each dowel bar.

- D. Secure in required position to prevent displacement during placing and finishing of concrete.
- E. Drill dowels into existing pavement, secure with epoxy, and provide paving headers as required to provide rigid pavement sections.
- F. Use sufficient number of chairs for steel reinforcement bars to maintain position of bars within allowable tolerances. Place reinforcement as shown on Drawings. In plane of steel parallel to nearest surface of concrete, bars shall not vary from plan placement by more than 1/12 of spacing between bars. In plane of steel perpendicular to nearest surface of concrete, bars shall not vary from plan placement by more than 1/4 inch.

3.06 FIBROUS REINFORCING

- A. Do not use fibrous reinforcing to replace structural, load-bearing, or moment-reinforcing steel.

3.07 PLACEMENT

- A. Place concrete when air temperature taken in shade and away from artificial heat is above 35 degrees F and rising. Do not place concrete when temperature is below 40 degrees F and falling.
- B. Place concrete within 90 minutes after initial water had been added. Remove and dispose of concrete not placed within this period.
- C. Concrete slump during placement shall be 2 to 6 inches, except when using traveling-form paver, slump shall be maximum of 2 inches.
- D. Deposit concrete continuously in successive batches. Distribute concrete in manner that will require as little rehandling as possible. Where hand spreading is necessary, distribute concrete with shovels or by other approved methods. Use only concrete rakes in handling concrete. At placement interruption of more than 30 minutes, place transverse construction joint at stopping point. Remove and replace sections less than 10 feet long.
- E. Take special care in placing and spading concrete against forms and at longitudinal and transverse joints to prevent honeycombing. Voids in edge of finished pavement will be cause for rejection.

3.08 COMPACTION

- A. Consolidate concrete using mechanical vibrators as specified herein. Extend vibratory unit across pavement, not quite touching side forms. Space individual vibrators at close enough intervals to vibrate and consolidate entire width of pavement uniformly. Mount mechanical vibrators to avoid contact with forms, reinforcement, transverse, or longitudinal joints.
- B. Furnish enough hand-manipulated mechanical vibrators for proper consolidation of concrete along forms, at joints and in areas not covered by mechanically controlled vibrators.

3.09 FINISHING

- A. Finish concrete pavement with power-driven transverse finishing machines or by hand finishing methods.
 - 1. Hand finish with mechanical strike and tamping template in same width as pavement to be finished. Shape template to pavement section shown on Drawings. Move strike

template forward in direction of placement, maintaining slight excess of material in front of cutting edge. Make minimum of two trips over each area. Screed pavement surface to required section. Work screed with combined transverse and longitudinal motion in direction work is progressing. Maintain screed in contact with forms. Use longitudinal float to level surface.

- B. On narrow strips and transitions, finish concrete pavement by hand. Thoroughly work concrete around reinforcement and embedded fixtures. Strike off concrete with strike-off screed. Move strike-off screed forward with combined transverse and longitudinal motion in direction work is progressing, maintaining screed in contact with forms, and maintaining slight excess of materials in front of cutting edge. Tamp concrete with tamping template. Use longitudinal float to level surface.
- C. After completion of straightedge operation, make first pass of burlap drag or transverse broom as soon as construction operations permit and before water sheen has disappeared from surface. Follow with as many passes as required to produce desired texture depth. Permit no unnecessary delays between passes. Keep drag wet, clean and free from encrusted mortar during use.

3.10 JOINTS AND JOINT SEALING

- A. Conform to requirements of Division 32.

3.11 CONCRETE CURING

- A. Conform to requirements of Division 32.

3.12 TOLERANCES

- A. Test entire surface before initial set and correct irregularities or undulations. Bring surface within requirements of following test and then finish. Place 10 foot straightedge parallel to center of roadway to bridge depressions and touch high spots. Do not permit ordinates measured from face of straight edge to surface of pavement to exceed 1/16 inch per foot from nearest point of contact. Maximum ordinate with 10 foot straightedge shall not exceed 1/8 inch. Grind spots in excess of required tolerances to meet surface test requirements. Restore texture by grooving concrete to meet surface finishing specifications.

3.13 FIELD QUALITY CONTROL

- A. Perform testing under provisions of Division 1.
- B. Compressive Strength Test Specimens: Make four test specimens for compressive strength test in accordance with ASTM C 31 for each 150 cubic yards or less of pavement that is placed in one day. Test one specimen at 7 days or at number of hours as directed by the Owner's Representative for high early strength concrete. Test two specimens at 28 days. Test remaining specimens at 56 days, if required. Test specimens in accordance with ASTM C 39. Minimum compressive strength shall be 3000 pounds per square inch for first two specimens and 3500 pounds per square inch at 28 days.
- C. When compressive test indicates failure, perform yield test in accordance with ASTM C 138 for cement content per cubic yard of concrete. When cement content is found to be less than that specified per cubic yard, increase batch weights until amount of cement per cubic yard of concrete conforms to requirements.

- D. Minimum of one 4 inch core will be taken at random locations per 375 feet per 12 feet lane or 500 square yards of pavement to measure in-place depth. Measure depth in accordance with ASTM C 174. Each core may be tested for 28 day compressive strength according to methods of ASTM C 42. 28 day compressive strength of each core tested shall be a minimum of 3000 pounds per square inch.
- E. Request, at option, three additional cores in vicinity of cores indicating nonconforming in-place depths at no cost to Owner. In-place depth at these locations shall be average depth of four cores.
- F. Fill cores and density test sections with new concrete paving or non shrink grout.

3.14 NONCONFORMING PAVEMENT

- A. Remove and replace areas of pavement found deficient in thickness, or that fail compressive strength tests, with concrete of thickness shown on Drawings.
- B. When measurement of any core is less than specified thickness, actual thickness of pavement in this area will be determined by taking additional cores at 10 foot intervals parallel to centerline in each direction from deficient core until, in each direction, core is taken which is not deficient by more than 10 percent. Exploratory cores for deficient thickness will not be used in averages for adjusted unit price. Exploratory cores are to be used only to determine length of pavement in unit that is to be removed and replaced. Replace nonconforming pavement sections at no additional cost to Owner.

3.15 PAVEMENT MARKINGS

- A. Restore pavement markings to match those existing in accordance with the applicable governmental standard specifications and details and Owner's Representative's requirements.

3.16 PROTECTION

- A. Barricade pavement section to prevent use until concrete has attained minimum design strength. Cure barricade pavement section for minimum 72 hours before use. Do not open pavement to traffic until concrete is at least 10 days old. Pavement may be open to traffic earlier provided Contractor pays for testing and additional specimen once 7 day specified strength is obtained. Pavement may be opened when high early strength concrete is used meeting specified 72 hour strength.
- B. High early strength concrete may be used to provide access at driveways, street intersections, esplanades and other locations approved by Owner's Representative.
- C. On those sections of pavement to be opened to traffic, seal joints, clean pavement, and place earth against pavement edges before permitting use by traffic. Opening of pavement to traffic shall not relieve responsibility for Work.
- D. Maintain concrete paving in good condition until completion of Work.
- E. Repair defects by replacing concrete to full depth.

END OF SECTION

SECTION 32 13 13.10 - CONCRETE PAVEMENT CURING

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Curing of Portland cement concrete paving.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices:
 - 1. Payment for concrete curing shall be incidental to concrete paving.
- B. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 REFERENCES

- A. ASTM C 156 - Standard Test Method for Water Retention by Concrete Curing Materials.
- B. ASTM C 171 - Standard Specifications for Sheet Materials for Curing Concrete.
- C. ASTM C 309 - Standard Specifications for Liquid Membrane-Forming Compounds for Curing Concrete.

1.4 SUBMITTALS

- A. Conform to requirements of Division 1.
- B. Submit manufacturer's product data for cover materials and liquid membrane-forming compounds.

PART 2 PRODUCTS

2.1 COVER MATERIALS FOR CURING

- A. Conform curing materials to one of the following:
 - 1. Polyethylene Film: Opaque pigmented white film conforming to requirements of ASTM C 171.
 - 2. Waterproofed Paper: Paper conforming to requirements of ASTM C 171.
 - 3. Cotton Mats: Single layer of cotton filler completely enclosed in cover of cotton cloth. Mats shall contain not less than 3/4 of a pound of uniformly distributed cotton filler per square yard of mat. Cotton cloth used for covering materials shall weigh not less than 6 ounces per square yard. Stitch mats so that mat will contact surface of pavement at all points when saturated with water.

2.2 LIQUID MEMBRANE-FORMING COMPOUNDS

- A. Conform liquid membrane-forming compounds to ASTM C 309. Membrane shall restrict loss of water to not more than 0.55 kg/m² in 72 hours using test method ASTM C 156.

PART 3 EXECUTION

3.1 CURING REQUIREMENT

- A. Cure concrete pavement by protecting against loss of moisture for period of not less than 72 hours immediately upon completion of finishing operations. Do not use membrane curing for concrete pavement to be overlaid by asphalt concrete.
- B. Failure to provide sufficient cover material shall be cause for immediate suspension of concreting operations.

3.2 POLYETHYLENE FILM CURING

- A. Immediately after finishing surface, and after concrete has taken its initial set, apply water in form of fine spray. Cover surface with polyethylene film so film will remain in direct contact with surface during specified curing period.
- B. Cover entire surface and both edges of pavement slab. Overlap joints in film sheets minimum of 12 inches. Immediately repair tears or holes occurring during curing period by placing acceptable moisture-proof patches or replacing.

3.3 WATERPROOFED PAPER CURING

- A. Immediately after finishing surface, and after concrete has taken its initial set, apply water in form of fine spray. Cover surface with waterproofed paper so paper will remain in direct contact with surface during specified curing period.
- B. Prepare waterproofed paper to form blankets of sufficient width to cover entire surface and both edges of pavement slab, and not be more than 60 feet in length. Overlap joints in blankets caused by joining paper sheets not less than 5 inches and securely seal with asphalt cement having melting point of approximately 180 degrees F. Place blankets to secure overlap of at least 12 inches. Immediately repair tears or holes appearing in paper during curing period by cementing patches over defects.

3.4 COTTON MAT CURING

- A. Immediately after finishing surface, and after concrete has taken its initial set, completely cover surface with cotton mats, thoroughly saturated before application, maintaining contact with surface of pavement equally at all points.
- B. Keep mats on pavement for specified curing period. Keep mats saturated so that, when lightly compressed, water will drip freely from them. Keep banked earth or cotton mat covering edges saturated.

3.5 LIQUID MEMBRANE-FORMING COMPOUNDS

- A. Immediately after free surface moisture, and after concrete has dispersed, apply liquid membrane-forming compound in accordance with manufacturer's instructions.
- B. Moisten concrete by water fogging prior to application of membrane when surface has become dry.
- C. Seal concrete surface with single coat at rate of coverage recommended by manufacturer and directed by Owner's Representative, but not less than one gallon per 200 square feet of surface area.

3.6 TESTING MEMBRANE

- A. Treated areas will be visually inspected for areas of lighter color of dry concrete as compared to dump concrete. Test suspected areas by placing few drops of water on surface. Membrane passes test when water stands in rounded beads or small pools which can be blown along surface of concrete without wetting surface.
- B. Re-Apply membrane compound immediately at no cost to Owner when membrane fails above test.

END OF SECTION

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SECTION 32 13 13.25 - CONCRETE SIDEWALKS

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Reinforced concrete sidewalks.
- B. Wheelchair ramps.
- C. Reinforced slope paving.

1.2 MEASUREMENT AND PAYMENT

- A. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 REFERENCES

- A. ASTM C 31 - Standard Practice for Making and Curing Concrete Test Specimens in Field.
- B. ASTM C 39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
- C. ASTM C 42 - Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
- D. ASTM C 138 - Standard Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete.
- E. ASTM C 143 - Standard Test Method for Slump of Hydraulic Cement Concrete.
- F. ASTM C 172 - Standard Practice for Sampling Freshly Mixed Concrete.
- G. ASTM D 698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
- H. Texas Accessibility Standards of Architectural Barriers Act, Article 9102, Texas Civil Statutes.

1.4 SUBMITTALS

- A. Conform to requirements of Division 1.
- B. CHPS Submittals:
 - 1. Product Data for Credit ME 4.1: For structural steel products (including reinforcing steel), documentation indicating percentages by weight of post-consumer recycled content. Project requirement is a minimum 67% post-consumer recycled content for all structural steel.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Concrete: Conform to material and proportion requirements for concrete of Division 32.
- B. Reinforcing Steel: Conform to material requirements of Division 32. Use No. 3 reinforcing bars.
- C. Preformed Expansion Joint Material: Conform to material requirements for preformed expansion joint material of Division 32.
- D. Expansion Joint Filler: Conform to material requirements for expansion joint material of Division 31.
- E. Forms: Use straight, unwarped wood or metal forms with nominal depth equal to or greater than proposed sidewalk thickness. The use of 2 inch by 4 inch lumber as forms will not be allowed.
- F. Sand Bed: Conform to material requirements for bank run sand of Division 31.
- G. Sodding: Conform to material requirements for sodding of Division 31.
- H. Coloring for wheelchair ramps: Conform to material requirements for colored concrete of Division 31. Color shall be Brick Red or as shown on the drawings.

PART 3 EXECUTION

3.1 REPLACEMENT

- A. Replace sidewalks and slope paving which are removed or damaged during construction with thickness and width equivalent to one removed or damaged, unless otherwise shown on Drawings. Finish surface (exposed aggregate, brick pavers, etc.) to match existing sidewalk.
- B. Provide replaced and new sidewalks with wheelchair ramps when sidewalk intersects curb at street or driveway.

3.2 PREPARATION

- A. Identify and protect utilities which are to remain.
- B. Protect living trees, other plant growth, and features designated to remain.
- C. Conduct clearing and grubbing operations in accordance with Division 31.
- D. Excavate subgrade 6 inches beyond outside lines of sidewalk. Shape to line, grade and cross section. For soils with plasticity index above 40 percent, stabilize soil with lime in accordance with Division 31. Compact subgrade to minimum of 90 percent maximum dry density at optimum to 3 percent above optimum moisture content, as determined by ASTM D 698.
- E. Immediately after subgrade is prepared, begin form work and concrete placement.

3.3 PLACEMENT

- A. Setting Forms: Straight, unwarped wood or metal forms with nominal depth equal to or greater than proposed sidewalk thickness. Use of 2 by 4's as forms will not be allowed. Securely stake forms to line and grade. Maintain position during concrete placement.
- B. Reinforcement:
 - 1. Install reinforcing bars.
 - 2. Install reinforcing steel as shown on the drawings. Lay longitudinal bars in walk continuously, except through expansion joints.
 - 3. Use sufficient number of chairs to support reinforcement in manner to maintain reinforcement in center of slab vertically during placement.
 - 4. Drill dowels into existing paving, sidewalk and driveways, secure with epoxy, and provide headers as required.
 - 5. Use sufficient number of chairs for steel reinforcement bars to maintain position of bars within allowable tolerances. Place reinforcement as shown on Drawings. In plane of steel parallel to nearest surface of concrete, bars shall not vary from plan placement by more than 1/12 of spacing between bars. In plane of steel perpendicular to nearest surface of concrete, bars shall not vary from plan placement by more than 1/4 inch.
- C. Expansion Joints: Install expansion joints with load transfer units in accordance with Division 32.
- D. Place concrete in forms to specified depth and tamp thoroughly with "jitterbug" tamp, or other acceptable method. Bring mortar to surface.
- E. Strike off to smooth finish with wood strike board. Finish smoothly with wood hand float. Brush across sidewalk lightly with fine-haired brush.
- F. Apply coating to wheelchair ramp with contrasting color in accordance with Division 32.
- G. Unless otherwise indicated on Drawings, mark off sidewalk joints 1/8 inch deep, at spacing equal to width of walk. Use joint tool equal in width to edging tool.
- H. Finish edges with tool having 1/4 inch radius.
- I. After concrete has set sufficiently, refill space along sides of sidewalk to one-inch from top of walk with suitable material. Tamp until firm and solid, place sod as applicable. Dispose of excess material in accordance with Division 1. Repair driveways and parking lots damaged by sidewalk excavation in accordance with Division 32.

3.4 CURING

- A. Conform to requirements of Division 32.

3.5 FIELD QUALITY CONTROL

- A. Testing will be performed under provisions of Division 1.
- B. Compressive Strength Test Specimens: Four test specimens for compressive strength test will be made in accordance with ASTM C 31 for each 30 cubic yards or less of sidewalk that is placed in one day. Two specimens will be tested at 7 days. Remaining two specimens will be tested at 28 days. Specimens will be tested in accordance with ASTM C 39. Minimum compressive strength: 2500 psi at 7 days and 3000 psi at 28 days.

- C. Yield test for cement content per cubic yard of concrete will be made in accordance with ASTM C 138. When cement content is found to be less than that specified per cubic yard, reduce batch weights until amount of cement per cubic yard of concrete conforms to requirements.
- D. If the Contractor places concrete without notifying the laboratory, the Owner will have the concrete tested by means of core test as specified in ASTM C 42. When concrete does not meet specification, cost of test will be deducted from payment.
- E. Sampling of fresh concrete shall be in accordance with ASTM C 172.
- F. Take slump tests when cylinders are made and when concrete slump appears excessive.
- G. Concrete shall be acceptable when average of two 28 day compression tests is equal to or greater than minimum 28 day strength specified.
- H. If either of two tests on field samples is less than average of two tests by more than 10 percent, that entire test shall be considered erratic and not indicative of concrete strength. Core samples will be required of in-place concrete in question.
- I. If 28 day laboratory test indicates that concrete of low strength has been placed, test concrete in question by taking cores as directed by Owner's Representative. Take and test at least three representative cores as specified in ASTM C 42 and deduct cost from payment due.

3.6 NONCONFORMING CONCRETE

- A. Remove and replace areas that fail compressive strength tests, with concrete of thickness shown on Drawings.
- B. Replace nonconforming sections at no additional cost to Owner.

3.7 PROTECTION

- A. Maintain newly place concrete in good condition until completion of Work.
- B. Replace damaged areas.

END OF SECTION

SECTION 32 13 73 - CONCRETE PAVING JOINTING

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Joints for concrete paving; concrete sidewalks, concrete driveways, curbs, and curb and gutters.
- B. Saw-cutting existing concrete or asphalt pavements for new joints.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices:
 - 1. No separate payment for street pavement expansion joints. Include cost for work in unit price bid for related work.
 - 2. No separate payment for saw-cutting existing concrete or asphalt pavement for new joints. Include cost for work in unit price bid for related work.
 - 3. No separate payment will be made for formed or sawed street pavement contraction joints and longitudinal weakened plane joints. Include cost for work in unit price bid for related work.
 - 4. No separate payment will be made for joints for curb, curb and gutter, concrete sidewalks, and concrete driveways. Include cost for work in unit price bid for related work.
- B. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 REFERENCES

- A. ASTM A 615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
- B. ASTM D 994 - Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).
- C. ASTM D 1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
- D. ASTM D 3405 - Standard Specification for Joint Sealants, Hot-Applied, for Concrete and Asphalt Pavements.
- E. TxDOT Tex-525-C - Tests for Asphalt and Concrete Joint Sealers.

1.4 SUBMITTALS

- A. Conform to requirements of Division 1.
- B. Submit product data for joint sealing compound and proposed sealing equipment for approval.
- C. Submit samples of dowel cup, metal supports, and deformed metal strip for approval. Submit manufacturer's recommendation for placing sealant(s).

PART 2 PRODUCTS

2.1 BOARD EXPANSION JOINT MATERIAL

- A. Filler board of selected stock. Use wood of density and type as follows:
 - 1. Clear, all-heart cypress weighing no more than 40 pounds per cubic foot, after being oven dried to constant weight.
 - 2. Clear, all-heart redwood weighing no more than 30 pounds per cubic foot, after being oven dried to constant weight.

2.2 PREFORMED EXPANSION JOINT MATERIAL

- A. Bituminous fiber and bituminous mastic composition material conforming to ASTM D 994 and ASTM D 1751.

2.3 JOINT SEALING COMPOUND

- A. Provide joint sealant as indicated on the drawings.

2.4 LOAD TRANSMISSION DEVICES

- A. Smooth, steel dowel bars conforming to ASTM A 615, Grade 60. When indicated on Drawings, encase one end of dowel bar in approved cap having inside diameter 1/16 inch greater than diameter of dowel bar.
- B. Deformed steel tie bars conforming to ASTM A 615, Grade 60.

2.5 SUPPORTS FOR REINFORCING STEEL AND JOINT ASSEMBLY

- A. Employ supports of approved shape and size that will secure reinforcing steel and joint assembly in correct position during placing and finishing of concrete. Space supports as directed by Owner's Representative.

PART 3 EXECUTION

3.1 PLACEMENT

- A. When new Work is adjacent to existing concrete, place joints at same location as existing joints in adjacent pavement.
- B. If limit of removal of existing concrete or asphalt pavement does not fall on existing joint, saw cut existing pavement minimum of 2 inches deep to provide straight, smooth joint surface without chipping, spalling, or cracks.

3.2 CONSTRUCTION JOINTS

- A. Place transverse construction joint wherever concrete placement must be stopped for more than 30 minutes. Place longitudinal construction joints at interior edges of pavement lanes using No. 6 deformed tie bars, 30 inches long and spaced 18 inches on centers.

3.3 EXPANSION JOINTS

- A. Place 3/4 inch expansion joints at radius points of curb returns for cross street intersections, or as located in adjacent pavement but no further than 80 feet apart or as shown on the drawings. Use no boards shorter than 6 feet. When pavement is 24 feet or narrower, use not more than 2 lengths of board. Secure pieces to form straight joint. Shape board filler

accurately to cross section of concrete slab. Use load transmission devices of type and size shown on Drawings unless otherwise specified or shown as "No Load Transfer Device."
Seal with joint sealing compound.

3.4 CONTRACTION JOINTS

- A. Place contraction joints at same locations as in adjacent pavement or at spaces indicated on Drawings. Place smoothed, painted, and oiled dowels accurately and normal to joint. Seal groove with joint sealing compound.

3.5 LONGITUDINAL WEAKENED PLANE JOINTS

- A. Place longitudinal weakened plane joints at spaces indicated on Drawings. If more than 15 feet in width is poured, longitudinal joint must be saw cut. Seal groove with joint sealing compound.

3.6 SAWED JOINTS

- A. Use sawed joints as alternate to contraction and weakened plane joints. Use circular cutter capable of cutting straight line groove minimum of 1/4 inch wide. Maintain depth of one quarter of pavement thickness. Commence sawing as soon as concrete has hardened sufficiently to permit cutting without chipping, spalling or tearing and prior to initiation of cracks. Once sawing has commenced, continue until completed. Make saw cut with one pass. Complete sawing within 24 hours of concrete placement. Saw joints at required spacing consecutively in sequence of concrete placement.
- B. Concrete Saw: Provide sawing equipment adequate in power to complete sawing to required dimensions and within required time. Maintain ample supply of saw blades at work site during sawing operations. Maintain sawing equipment on job during concrete placement.

3.7 JOINTS FOR CURB, CURB AND GUTTER

- A. Place 3/4 inch preformed expansion joints through curb and gutters at locations of expansion and contraction joints in pavement, at end of radius returns at street intersections and driveways, and at curb inlets. Maximum spacing shall be 120-foot centers.

3.8 JOINTS FOR CONCRETE SIDEWALKS

- A. Provide 3/4 inch expansion joints conforming to ASTM A 1751 along and across sidewalk at back of curbs, at intersections with driveways, steps, and walls; and across walk at intervals not to exceed 40 feet.

3.9 JOINTS FOR CONCRETE DRIVEWAYS

- A. Provide 3/4-inch expansion joints conforming to ASTM D 1751 across driveway in line with street face of sidewalks, at existing concrete driveways, and along intersections with sidewalks and other structures. Extend expansion joint material full depth of slab.

3.10 JOINT SEALING

- A. Seal joints only when surface and joints are dry, ambient temperature is above 50 degrees F and less than 85 degrees F and weather is not foggy or rainy.

- B. Use joint sealing equipment in like new working condition throughout joint sealing operation and be approved by Owner's Representative. Use concrete grooving machine or power-operated wire brush and other equipment such as plow, brooms, brushes, blowers or hydro or abrasive cleaning as required to produce satisfactory joints.
- C. Clean joints of loose scale, dirt, dust and curing compound. The term joint includes wide joint spaces, expansion joints, dummy groove joints or cracks, either preformed or natural. Remove loose material from concrete surfaces adjacent to joints.
- D. Fill joints neatly with joint sealer to depth shown. Pour sufficient joint sealer into joints so that, upon completion, surface of sealer within joint will be 1/4 inch above level of adjacent surface or at elevation as directed.

3.11 PROTECTION

- A. Maintain joints in good condition until completion of Work.
- B. Replace damaged joints material with new material as required by this Section.

END OF SECTION

SECTION 32 16 13 - CURBS AND GUTTERS

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Reinforced concrete curb, reinforced monolithic concrete curb and gutter, and mountable curb.
- B. Paving headers and railroad headers poured monolithically with concrete base or pavement.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices:
 - 1. Payment for reinforced concrete curb, reinforced monolithic concrete curb and gutter, and mountable curb, when included on the bid form, is on a linear foot basis measured along face of curb.
- B. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 SUBMITTALS

- A. Conform to requirements of Division 1.
- B. Submit details of proposed form work for approval.
- C. CHPS Submittals:
 - 1. Product Data for Credit ME 4.1: For structural steel products (including reinforcing steel), documentation indicating percentages by weight of post-consumer recycled content. Project requirement is a minimum 67% post-consumer recycled content for all structural steel.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Concrete: Conform to material and proportion requirements for concrete of Division 32.
- B. Reinforcing Steel: Conform to material requirements for welded wire fabric of Division 32.
- C. Grout: Nonmetallic, nonshrink grout containing no chloride producing agents conforming to following requirements.
 - 1. Compressive strength
 - a. at 7 days: 3500 psi
 - b. at 28 days: 4000 psi
 - 2. Initial set time: 45 minutes
 - 3. Final set time: 1.5 hours
- D. Preformed Expansion Joint Material: Conform to material requirements for preformed expansion joint material of Division 32.

- E. Expansion Joint Filler: Conform to material requirements for expansion joint filler of Division 32.
- F. Mortar: Mortar finish composed of one part Portland cement and 1 1/2 parts of fine aggregate. Use only when approved by Owner's Representative.

PART 3 EXECUTION

3.1 PREPARATION

- A. Prepare subgrade in accordance with applicable portions of sections on excavation and fill, embankment, and sub grade and roadbed.

3.2 PLACEMENT

- A. Guideline: Set to follow top line of curb. Attach indicator to provide constant comparison between top of curb and guideline. Ensure flow lines for monolithic curb and gutters conform to slopes indicated on Drawings.
- B. Forms: Brace to maintain position during pour. Use metal templates cut to section shown on Drawings.
- C. Reinforcement: Secure in position so that steel will remain in place throughout placement. Reinforcing steel shall remain at approximate center of base or pavement as indicated on Drawings.
- D. Joints: Place in accordance with Division 32. Place dummy groove joints at to match concrete pavement joints at right angles to curb lines. Cut dummy grooves 1/4 inch deep using approved edging tool.
- E. Place concrete in forms to required depth. Consolidate thoroughly. Do not permit rock pockets in form. Entirely cover top surfaces with mortar.

3.3 MANUAL FINISHING

- A. After concrete is in place, remove front curb forms. Form exposed portions of curb, and of curb and gutter, using mule which conforms to curb shape, as shown on Drawings.
- B. Thin coat of mortar may be worked into exposed face of curb using mule and two-handled wooden darby at least 3 feet long.
- C. Before applying final finish move 10 foot straightedge across gutter and up curb to back form of curb. Repeat until curb and gutter are true to grade and section. Lap straightedge every 5 feet.
- D. Steel trowel finish surfaces to smooth, even finish. Make face of finished curb true and straight.
- E. Edge outer edge of gutter with 1/4 inch edger. Finish edges with tool having 1/4 inch radius.
- F. Finish visible surfaces and edges of finished curb and gutter free from blemishes, form marks and tool marks. Finished curb or curb and gutter shall have uniform color, shape and appearance.

3.4 MECHANICAL FINISHING

- A. Mechanical curb forming and finishing machines may be used instead of, or in conjunction with, previously described methods, when approved by Owner's Representative. Use of mechanical methods shall provide specified curb design and finish.

3.5 CURING

- A. Immediately after finishing operations, cure exposed surfaces of curbs and gutters in accordance with Division 32.

3.6 TOLERANCES

- A. Top surfaces of curb and gutter shall have uniform width and shall be free from humps, sags, or other irregularities. Surfaces of curb top, curb face and gutter shall not vary more than 1/8 inch from edge of straightedge laid along them, except at grade changes.

3.7 PROTECTION

- A. Maintain curbs and gutters in good condition until completion of Work.
- B. Replace damaged curbs and gutters to comply with this Section.

END OF SECTION

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SECTION 32 17 23 – PAVEMENT MARKINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. This Section specifies the requirements for providing pavement markings of the following types.

1.2 UNIT PRICES

- A. Measurement and payment for pavement markings is on a lump sum basis.

1.3 QUALITY ASSURANCE

- A. All markings shall comply with the requirements of the SDHPT Standard Specifications for Construction of Highways, Streets and Bridges, the SDHPT Manual on Uniform Traffic Control Devices for Streets and Highways and the applicable regulations and standards of Harris County, Texas, and the City.

- B. Reference Standards Applicable to this Section:

- 1. SDHPT: Texas State Department of Highways and Public Transportation:

- a. Standard Specifications for Construction of Highways, Streets and Bridges.
- b. Texas Manual on Uniform Traffic Control Devices for Streets and Highways (TMUTCD).
- c. The above referenced SDHPT standards may be obtained from:

State Department of Highways & Public Transportation Highway Building
11th and Brazos Streets
Austin, Texas 78701
Tel: (512) 475-2081

- 2. Conform to current federal VOC (Volatile Organic Compounds) regulations.

1.4 SUBMITTALS

- A. Certificates:

- 1. Certificates shall be submitted for each product indicating that the product complies with the requirements of this specification.

- B. Manufacturer's Data:

- 1. Manufacturer's installation instructions, specifications and recommendations shall be submitted for each pavement marking product.

1.5 JOB CONDITIONS

- A. Markings shall be installed only on clean and dry surfaces. Paint markings shall be applied only when surfaces have the following minimum temperatures:

- 1. A minimum of 50 degrees F for asphalt and a minimum of 60 degrees F for concrete.

PART 2 PRODUCTS

2.1 MATERIALS

A. Paint:

1. Marking paint shall be traffic white, yellow, or as designated on the drawings.
2. Fast Drying Alkyd, Low VOC Chlorinated Rubber Traffic Paint.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Surface condition / preparation: Asphalt and concrete surfaces should be cured, clean, dry and sound. Loose and lifting paint should be removed prior to application. Concrete with sealers containing silicone, having a smooth finish, or efflorescence should be removed by etching or abrasive blasting, as these conditions may interfere with adhesion. While new asphalt surfaces vary in length of time required for curing, insufficient curing may result in bleeding. Not recommended for use over asphalt sealers. Regardless of surface condition, a test stripe should be placed inconspicuously to determine if surface is suitable before continuing.
- B. Markings shall be installed, and surfaces prepared in accordance with the requirements of the applicable item in the SDHPT Standard Specifications and the TMUTCD.
- C. Markings shall be protected from vehicular traffic until not subject to damage by such traffic. Contractor shall be responsible for repair and replacement of markings until written acceptance by the Owner.

END OF SECTION

SECTION 32 18 28 - TENNIS COURTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Design, engineering and construction of post-tensioned concrete tennis courts.
2. Tennis court related fencing and gates.
3. Wind screens.
4. Nets, posts and hardware.
5. Surfacing and court markings.
6. Court lighting.

B. Scope of Work: The "Work" of this Section is defined to include, but not necessarily to be limited to:

1. Requirements indicated are to establish a minimum standard. Provide tennis court work to meet these standards, but in no case less than those required by the Tennis Court Design Engineer.
2. The scope of this work shall be the construction of the Tennis Courts as on the site plans as a complete and whole construction package including, but not be limited to, the engineered design of the Tennis Courts concrete slab and foundation, and fencing. Further, the scope of work shall include, but not be limited to the furnishing and installation or construction of the Tennis Courts including the concrete footings, concrete slab, reinforcing, pad preparation as recommended by the geotechnical report, all soil stabilization below and five feet outside the perimeter of the slab, fencing, nets, posts, and windscreens. In addition to the court, provide lighting Poles, fixtures, all necessary wiring, electrical panels, transformers, timers, and electrical service to the Tennis Courts from the nearest power service.
3. Tennis Courts shall comply with the latest U.I.L. rules and regulation and be constructed to comply with United States Tennis Association (USTA) Specifications.
4. Entire system including but not limited to, courts, fencing, equipment and lighting along with any other accessory items, shall be designed as a performance specification. A Professional Engineer licensed in the State of Texas shall seal the court designs submitted.
5. A full copy of the geotechnical report has been included in the project manual.

C. Related Sections:

1. Section 00 31 32 - Geotechnical Data.
2. Section 03 30 00 - Cast-In-Place Concrete.
3. Section 03 38 00 - Post-Tensioned Concrete.
4. Section 26 56 67 - Sports Field Lighting System

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Conduct a preinstallation meeting two weeks prior to the start of the work of this section; require attendance by all affected installers.
- B. Coordination: Coordinate the installation of court lighting with size, location and installation of service utilities.

- C. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.3 SUBMITTALS

- A. Product data: Within 15 calendar days after the Contractor has received the Owner's Notice to Proceed, submit the following:
 - 1. Materials list of items proposed to be provided under this Section, and related Sections;
 - 2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements; including color samples.
 - 3. Shop drawings requirements for submission to the local AHJ for permitting.
- B. Manufacturer's recommended installation procedures which, when approved by the Architect, will become the basis for accepting or rejecting actual installation procedures used on the Work.
- C. Shop Drawings:
 - 1. Submit sealed design documents and calculations for submission to the local AHJ for permitting requirements and A/E review.
 - a. Foundation Design
 - b. Dimensioned court layouts
 - c. Equipment locations.
 - d. Fencing calculations and layouts
 - e. Striping width and color.
 - f. Proposed colored graphic or logo.
 - 2. Shop drawing sheets that include engineering information designed by the Contractor's Delegated Design Engineer shall be signed and sealed in accordance with the Texas Engineering Practice Act. Sheets that do not provide information designed by the Contractor's Engineer do not require being signed and sealed. Calculation packages require a signed and sealed cover sheet only. Any submittals requiring to be signed and sealed that are received without the signature and seal will be rejected without review.
 - 3. Submit a copy of the latest U.I.L. rules and regulations verifying compliance.
- D. Samples: Accompanying the submittal described above, submit Samples of each sealant, each backing material, each primer, and each bond breaker proposed to be used.

1.4 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 Texas.
- B. Tennis Court Contractor shall have completed at least ten (10) similar size tennis court projects in the last three years.
- C. Surfacing applicator shall have a minimum of one hundred (100) tennis court applications of proven experience.
- D. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- E. Submission of Substitute Materials:

1. If other than the product specified, submit at least five working days prior to the bid date a complete type written list of all such proposed substitutions together with sufficient data, drawings, samples, literature, and other detailed information as will demonstrate to the satisfaction of the Owner that the proposed substitute material is equal in quality and utility to that originally specified. Under no circumstances will a surfacing system comprised of several products produced or manufactured from different sources be considered.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. See Section 01 60 00 - Product Requirements, for transportation, handling, storage and protection procedures.
- B. Do not use material which has exceeded the shelf life recommended by its manufacturer.

1.6 FIELD CONDITIONS

- A. Ambient Conditions: Do not install materials when environmental conditions are outside of the acceptable ranges recommended by the manufacturer.
- B. Weather Limitations: No part of the construction involving the surfacing system may be conducted during rain or when rain is imminent. The air and surface temperature must be at least 50 deg. F. and rising. Do not apply when surface temperature is above 140 deg. F.
- C. Existing Conditions: See subsurface investigation report; see Section 00 31 32.

1.7 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Provide three year manufacturer warranty for windscreens.
- C. System Warranty:
 1. Provide a written guarantee warranting the entire system, including all materials, devices, and workmanship to be free of defects for a period of five (5) years from the date of completion, unless otherwise indicated. Any defects in materials, devices, and workmanship which become apparent within the guarantee period shall be repaired or replaced by the contractor at his own expense, and at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 GENERAL

- A. The materials and installation of foundations, synthetic surfaces, fences, equipment for tennis courts and tennis court lighting indicated are a part of these specifications are minimum standards but shall be in no case less than those required by the Design Engineer.

2.2 TENNIS COURT POST-TENSIONED SLAB

- A. See Section 03 38 00 - Post-Tensioned Concrete.

2.3 TENNIS COURT LIGHTING

- A. See Section 26 56 68 - Tennis Court Lighting

2.4 TENNIS COURT COLOR SURFACING

A. Manufacturers:

1. California Products Corp.; Plexipave System: www.plexipave.com.
2. Hellas Constrction; Model TPS 5000: www.hellasconstruction.com
3. Substitutions: See Section 01 60 00 - Product Requirements.

B. Materials:

1. Patching Mix (California Court Patch Binder) - for use in patching cracks, holes, depressions and other surface imperfections.
2. Crack Filler (Plexipave Crack Filler) - for use in filling fine cracks.
3. Concrete Preparer - specially formulated acid heat for use in neutralizing the concrete in preparation for the Plexipave System.
4. Adhesion Primer - (California TiCoat) - two component water based epoxy primer for uncoated concrete surfaces.
5. Acrylic Filler Course (California Acrylic Resurfacer) - for use as a filler for new or existing concrete surfaces. The 100% acrylic filler shall be blended with approved silica sand at the job site.
6. Acrylic Color Playing Surface (Plexichrome/Plexipave Color Base) - for use as the finish color and texture. Plexichrome and Plexipave Color Base are blended at the job site to achieve the correct surface texture. Factory Fortified Plexipave may be used as an alternative material.
7. Line Paint (California Line Paint) - for use as the line marking on the court/play surface.
8. Water: - for use in dilution/mixing shall be clean and potable.

2.5 TENNIS COURT CHAIN LINK FENCING

A. Height

1. Height of fence shall be 12' - 0".

B. Fabric

1. Nine gauge (9 Ga.) black resin clad fabric shall have a polyvinyl chloride coating, minimum wall thickness of .015 inches over a galvanized substrate. The base metal shall have a minimum breaking strength of five hundred fifty pounds (550 lbs.) and a zinc coat weight of .1503 pounds per square foot of uncoated wire surface. Top and bottom salvage of the fabric shall be knuckled with one and three-quarters inch mesh.

C. Pipe and Accessories

1. Method of Manufacturing: Pipe used for fence framework shall be cold rolled and electric-resistance-welded from steel conforming to ASTM A-569 and hot dip galvanized to ASTM A-525 G-90 zinc weight both inside and outside the pipe. The outside then receives a conversion coating and fusion bonded black polyester powder coating. the application of the coating will consist of three (3.0) mils of cured thermosetting polyester powder coatings applied over zinc phosphate pretreatment of galvanized steel.

2. Posts: All line, and gateposts shall be two and seven-eighths inch outside diameter (2 7/8" O.D.) with a wall thickness of eleven gauge (11 Ga.) and a minimum yield strength of fifty-five thousand pounds per square inch (55,000 psi). Corner posts shall be 4" pipe, outside diameter, 9.1 lbs. per ft.
 3. Rails: Shall be one and five-eighths inch outside diameter (1 5/8" O.D.) pipe with a wall thickness of thirteen gauge (13 Ga.) and a minimum yield strength of fifty five thousand pounds per square inch (55,000 psi) and provided with seven inch long expansion sleeve couplings. Provide top, middle and bottom rails.
 4. Accessories:
 - a. Fabric Ties: Eleven gauge (11 Ga.) galvanized steel tie wire to fasten fabric to framework. Tension wire shall be attached to fabric bottom with heavy galvanized hog rings.
 - b. Tension Wire: Two (2) strands of twelve and half gauge (12.5 Ga.) steel wire twisted together.
 - c. Tension Bands: Beveled edge type with nuts and bolts.
 - d. Line Post Tops: Heavy galvanized cast from eye top fitting.
 - e. Terminal Post Tops: Heavy galvanized iron tops of bullet type construction.
 - f. Coating: All accessories to receive black polyester powder coating.
 5. Gates: Construct gate frames with one and five-eighths inches outside diameter (1 5/8" O.D.) rail material with welded corners. Provide fabric filler same as used in fence and use heavy duty galvanized hardware with lockable latches.
- D. Workmanship: The complete fence shall be plumb, both in line and transverse to the fence, straight and rigid with fabric tightly stretched and held firmly in place. Details of construction not specified, shall be performed in keeping with standard good fencing practices.
- E. Posts: Space all posts not more than eight feet apart and set in concrete, as shown on the drawings.
- F. Rails: Set rails as nearly parallel to the finish grade as possible and at the specified height of the fence.
- G. Fabric Ties: Provide a minimum of six (6) ties for each ten-foot of rail and one tie to each foot of post height. Ties to tension wire shall be made with heavy galvanized hog rings at six (6) per ten foot of tension wire.
- H. Tension Bands: Provide one (1) fastener for each one foot of fabric height.
- I. Gates:
 1. Size: Clear opening 3 feet wide by 7 feet high.
 2. Provide with transom extending above gate opening to top of fence height indicated.
- 2.6 TENNIS COURT EQUIPMENT
- A. Manufacturers / Suppliers:
 1. E.J. Renner and Associates, Inc., Denver, CO.
 2. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Tennis Net Posts
 1. Model: Vogue 2.5.

2. Internal brass worm-gear take-up, baked-on black polyester powder coating, continuous lacing rod, and galvanized sleeves. Two and half inches (2 ½") square with three-sixteenths inch wall thickness.
3. Set in concrete foundations three feet deep by two feet diameter. Net posts to be laid out according to the United States Tennis Court and Track Builders Association specifications.

C. Nets

1. Model: Edwards 30LS Double Top Net.
2. 3.5 mm double stitched, braided polyethylene (three hundred ten pound – 310 lb. test) body, top six rows of net body are double mesh with extra heavy spun polyester headband.
3. Hung flush with the net posts and thirty-six inches high in the center.

D. Center Straps

1. Model: TWCS.
2. Two and one-eighth inches wide, white nylon webbing with adjusting buckle and bottom snap hook.
3. Loop strap around net, hook into anchor, and tighten so that the net is thirty-six inches high in the center.

E. Center Strap Anchor

1. Model: GAS-30.
2. Anchor is tubular pipe nine inches long by one and seven-eighths inches diameter with a three-sixteenth inch anchoring pin.
3. Set in concrete eight inches by eight inches.

F. Windscreen Curtain

1. Nine foot high Dacron windscreen fabricated of seven ounce (7 oz.) open mesh polyester with brass grommets every twelve inches along the top, bottom, and sides.
2. The nine foot high curtains shall be accurately measured, fabricated, and attached with nine gauge (9 Ga.) galvanized hog rings and #8 polyrope for the center seam.

PART 3 - EXECUTION

3.1 SOIL PREPARATION UNDER THE TENNIS COURTS SLAB

- A. The Contractor's Tennis Court Engineer shall review the geotechnical report(s) and submit proposed soil preparation under the tennis court to the Architect. The soil preparation shall achieve a reduction in the estimated potential vertical movement so that the estimated potential vertical movement is no more than one (1) inch according to the Geotechnical Engineer. The soil preparation shall be in accordance with the recommendations of the Geotechnical Report(s) provided with this Project Manual. If the Geotechnical Engineering report does not provide recommendations for reducing the potential vertical movement to no more than one (1) inch, Proposers shall not assume what will be acceptable but instead shall request information from the Architect at least five (5) days before submitting a proposal. If the Geotechnical Engineering report does not provide recommendations for achieving no more than a one (1) inch estimated potential vertical movement and a request for information is not submitted to the Architect at least five (5) days before Proposals are submitted, and the Proposal is accepted by the Owner, the Contractor shall be responsible for all costs to prepare the soil as recommended by the Geotechnical Engineer to achieve an estimated potential vertical movement of no more

than one (1) inch.

3.2 INSTALLATION - TENNIS COURT POST-TENSIONED SLAB

- A. See Section 03 38 00 - Post-Tensioned Concrete.

3.3 INSTALLATION - TENNIS COURT LIGHTING

- A. See Section 26 56 67 - Sports Field Lighting System.

3.4 INSTALLATION - TENNIS COURT COLOR SURFACING

- A. Install in accordance with manufacturer's instructions.
- B. Verify that fencing, drainage, adjacent landscaping, lighting, net posts, center strap anchors, and any curb and gutter work is completed prior to color surfacing.
- C. Surface Preparation: Concrete shall have a wood float or broom finish. DO NOT STEEL TROWEL CONCRETE. DO NOT ALLOW ANY CURING AGENTS OR HARDENERS TO BE USED. Concrete must cure for 28 days. Thoroughly remove all dirt, dust, mud, oil, and foreign matter.
- D. The court(s) shall be flooded to check for depressions and irregularities. All depressions ponding water that covers the thickness of a nickel shall be outlined with a construction crayon and filled after acid treating the surface.
- E. Concrete Preparer: Concrete surface must be treated with concrete Preparer solution. After drying, all latent material must be removed from the surface.
- F. All depressions requiring correction shall be filled with Court Patch Binder according to specifications using the following mix:
1. 100 lbs. 60 –80 mesh silica sand (dry).
 2. 3 gallons Plexipave court Patch Binder.
 3. 1 to 2 gallons Portland Cement (depending on temperature and humidity).
 4. Tack Coat – Tack coat is necessary under patches only and shall be as follows:
 - a. Plexipave Court Patch Binder diluted 1 part Court patch Binder to 2 parts water and allowed to dry prior to patching. After patching, the surface shall not vary more than 1/8 inch in 10 ft. measured in any direction.
- G. Primer Coat: Mix and apply California Ti-Coat epoxy primer according to Specification 10.17. NOTE: Plexibond may be used as an alternate for priming concrete courts.
- H. Acrylic Filler Coat: In order to provide a smooth, dense underlayment for the textured color surfacing, one or more applications of California Acrylic Resurfacer shall be applied to the surface according to specifications utilizing the following mix:
1. Acrylic Resurfacer – 55 gallons
 2. Water - 20-40 gallons
 3. Liquid yield = 112-138 gallons
 4. Sand (60 – 80 mesh) 600-900 lbs.

- I. Fortified Plexipave Textured Coats shall be applied by a rubber blade squeegee on the clean, dry surface in 3 applications. To obtain the proper application consistency, the Fortified Plexipave shall be mixed as follows:
 - 1. Plexipave Color Base – 30 gallons
 - 2. Plexichrome – 20 gallons
 - 3. Water – 20 gallons
 - 4. The finished surface shall have a uniform appearance and be free from ridges and tool marks. Colors shall be as selected by the Architect.

- J. Playing Lines – Textured playing lines shall be accurately located, marked and painted with Plexicolor Line Paint, as specified by the U.S. Tennis Association.

3.5 INSTALLATION - TENNIS COURT CHAIN LINK FENCING

- A. Install according to the Chain Link Manufacturers Institute recommendations, these specification or the Design Engineer, whichever is greater.

3.6 INSTALLATION - TENNIS COURT EQUIPMENT

- A. Install according to the manufacturer's recommendation for each component.

3.7 ADJUSTING

- A. Align gates flush with the plane of the fence.

3.8 CLEANING

- A. Upon completion, remove all containers, surplus material and debris, and leave the site in a clean and orderly condition acceptable to the Owner.

PART 4 - END OF SECTION

SECTION 32 91 13.13 - TOPSOIL PLACEMENT AND GRADING

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Furnishing and placing topsoil for finish grading and for seeding, sodding, and planting in areas other than designated athletic fields.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices:
 - 1. Payment for topsoil is on a cubic yard basis.
 - 2. Payment for grading shall be incidental to the project unless included on the bid form.
- B. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

PART 2 PRODUCTS

2.1 TOPSOIL

- A. Topsoil shall be fertile, friable, natural sandy loam surface soil obtained from excavation or borrow operations having following characteristics:
 - 1. pH value of between 5.5 and 6.5
 - 2. Liquid limit: 50 or less
 - 3. Plasticity index: 20 or less
 - 4. Gradation: maximum of 10 percent passing No. 200 sieve
- B. Topsoil shall be reasonably free of subsoil, clay lumps, weeds, non-soil materials, and other litter or contamination. Topsoil shall not contain roots, stumps, and stones larger than 2 inches.
- C. Obtain topsoil from naturally well-drained areas where topsoil occurs at minimum depth of 4 inches and has similar characteristics to that found at placement site. Do not obtain topsoil from areas infected with growth of, or reproductive parts of nut grass or other noxious weeds.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Excavate topsoil for esplanades and areas to receive grass or landscaping from areas to be further excavated. Stockpile in area approved by Owner's Representative.
- B. Stockpile topsoil to depth not exceeding 8 feet. Cover to protect from erosion.

3.2 TOPSOIL EXCAVATION

- A. Conform to excavation and stockpiling requirements of Division 31.

3.3 PLACEMENT

- A. Place no topsoil until subgrade has been approved. For areas to be seeded or sodded, scarify or plow existing material to minimum depth of 4 inches, or as indicated on Drawings. Remove vegetation and foreign inorganic material. Place 4 inches of topsoil on loosened material and roll lightly with appropriate lawn roller to consolidate topsoil.
- B. Increase depth of topsoil to 6 inches when placed over sand bedding and backfill materials specified in Division 31.
- C. For areas to receive shrubs or trees, excavate existing material and place topsoil to depth and dimensions shown on Drawings.
- D. Remove spilled topsoil from curbs, gutters, and, paved areas and dispose of excess topsoil in accordance with requirements of Division 1.
- E. Place topsoil to promote good drainage and compact with light roller. Water topsoil after placement until saturated for minimum depth 6 inches, fill in and recompact areas of settlement.

3.4 PROTECTION

- A. Protect topsoil from wind and water erosion until planting is completed.

END OF SECTION

SECTION 32 92 13 - HYDRO-MULCHING

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Seeding, fertilizing, mulching, and maintenance in areas other than designated athletic fields.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices:
 - 1. Payment for Hydro-mulch is on a per acre basis.
- B. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract; payment for work in this Section is included in total Stipulated Price.

1.3 SUBMITTALS

- A. Conform to requirements of Division 1.
- B. Submit certification from supplier that each type of seed conforms to these specifications and requirements of Texas Seed Law. Certification shall accompany seed delivery.
- C. Submit certificate stating that fertilizer complies with these specifications and requirements of Texas Fertilizer Law.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Topsoil: Conform to material requirements of Division 32.
- B. Seed: Conform to U.S. Department of Agriculture rules and regulations of Federal Seed Act and Texas Seed Law. Seed shall be certified 90 percent pure and furnish 80 percent germination and meet following requirements:
 - 1. Rye: Fresh, clean, Italian rye grass seed (*loium multi-florum*), mixed in labeled proportions. As tested, minimum percentages of impurities and germination must be labeled. Deliver in original unopened containers.
 - 2. Bermuda: Extra-fancy, treated, lawn type common bermuda (*Cynodon dactylon*). Deliver in original, unopened container showing weight, analysis, name of vendor, and germination test results.
 - 3. Wet, moldy, or otherwise damaged seed will not be accepted.
 - 4. Seed requirements, application rates, and planting dates are:

| TYPE | APPLICATION RATE POUNDS/A | PLANTING DATE |
|-------------------------------------|---------------------------|-----------------|
| Hulled Common Bermuda Grass 98/88 | 40 | Jan 1 to Mar 31 |
| Unhulled Common Bermuda Grass 98/88 | 40 | |
| Hulled Common Bermuda Grass 98/88 | 40 | Apr 1 to Sep 30 |
| Hulled Common Bermuda Grass 98/88 | 40 | Oct 1 to Dec 31 |
| Unhulled Common Bermuda Grass 98/88 | 40 | |
| Annual Rye Grass (Gulf) | 30 | |

- C. Fertilizer: Dry and free flowing, inorganic, water soluble commercial fertilizer, which is uniform in composition. Deliver in unopened containers which bear manufacturers guaranteed analysis. Caked, damaged, or otherwise unsuitable fertilizer will not be accepted. Fertilizer shall contain minimum percentages of following elements:
 - 1. Nitrogen: 10 Percent
 - 2. Phosphoric Acid: 20 Percent
 - 3. Potash: 10 Percent
- D. Mulch:
 - 1. Virgin wood cellulose fibers from whole wood chips having minimum of 20 percent fibers 0.42 inches in length and 0.01 inches in diameter.
 - 2. Cellulose fibers manufactured from recycled newspaper and meeting same fiber content and size as for cellulose fibers from wood chips.
 - 3. Dye mulch green for coverage verification purposes.
- E. Soil Stabilizer: "Terra Tack 1" or approved equal.
- F. Weed control agent: Pre-emergent herbicide for grass areas, such as "Benefin," or approved equal.

PART 3 EXECUTION

3.1 PREPARATION

- A. Place and compact topsoil in accordance with requirements of Division 32.
- B. Dispose of Objectionable and Waste Materials in accordance with Division 1.

3.2 APPLICATION

- A. Seed: Apply uniformly at rates given in Paragraph 2.01 B for type of seed and planting date.
- B. Fertilizer: Apply uniformly at rate of 500 pounds per acre.
- C. Mulch: Apply uniformly at rate of 50 pounds per 1000 square feet.
- D. Soil Stabilizer: Apply uniformly at rate of 40 pounds per acre.
- E. Weed Control Agent: Apply at manufacturer's recommended rate prior to hydro mulching.

- F. Sod: Lay single row of sod along perimeter where topsoil and pavement intersect. Apply in conformance to Division 32.
- G. Suspend operations under conditions of drought, excessive moisture, high winds, or extreme or prolonged cold. Obtain Owner's Representative approval before resuming operations.

3.3 MAINTENANCE

- A. Maintain grassed areas minimum of 90 days, or as required to establish an acceptable lawn. For areas seeded in fall, continue maintenance following spring until acceptable lawn is established.
- B. Maintain grassed areas by watering, fertilizing, weeding, and trimming.
- C. Repair areas damaged by erosion by regrading, rolling, and replanting.
- D. Reseed small, sparse grass areas. When sparse areas exceed 20 percent of planted area, reseed by hydro mulch.
- E. Mow grass when height reaches 3 1/2 inches or greater on average before final acceptance. Mow to height of 2 1/2 inches.

END OF SECTION

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SECTION 32 92 23 - SODDING

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Restoration of existing lawn areas disturbed by construction shall be by installation of new sod.
- B. Planting of sod within areas designated on Drawings for purpose of surface stabilization, channel stabilization or vegetation buffer strips.
- C. Sod is defined as blocks, squares, strips of turfgrass, and adhering soil used for vegetative planting. To be placed edge to edge for complete coverage.
- D. Lawn is defined as ground covered with fine textured grass kept neatly mowed.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices
 - 1. Payment for sodding is on square yard basis.
 - 2. Refer to Division 1 for unit price procedures.
- B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 SUBMITTALS

- A. Conform to requirements of Division 1.

1.4 QUALITY ASSURANCE

- A. Sod only when weather and soil conditions are deemed by Owner's Representative to be suitable for proper placement.
- B. Water and fertilize new sod.
- C. Guarantee sod to be growing 30 days after substantial completion.
- D. Maintenance Period:
 - 1. Begin maintenance immediately after each section of grass sod is installed and continue for 30 day period from date of substantial completion.
 - 2. Resod unacceptable areas.
 - 3. Water, fertilize, control disease and insect pests, mow, edge, replace unacceptable materials, and perform other procedures consistent with good horticultural practice to ensure normal, vigorous, and healthy growth. Install disease control within guidelines set forth by Structural Pest Control Board of the State of Texas.
- E. Notify Owner's Representative 10 days before end of maintenance period for inspection.

PART 2 PRODUCTS

2.1 SOD

- A. Species: Bermuda (*Cynodon Dactylon*), Buffalo (*Buchloe Dactyloides*), or St. Augustine (*Stenotaphrum Secundatum*) Gulf Coast variety to match existing sod.
- B. Contents: 95 percent permanent grass suitable to climate in which it is to be placed; not more than 5 percent weeds and undesirable grasses; good texture, free from obnoxious grasses, roots, stones and foreign materials.
- C. Size: 12-inch-wide strips, uniformly 2 inches thick with clean-cut edges.
- D. Sod is to be supplied and maintained in healthy condition as evidenced by grass being normal green color.

2.2 FERTILIZER

- A. Available nutrient percentage by weight: 12 percent nitrogen, 4 percent phosphoric acid, and 8 percent potash; or 15 percent nitrogen, 5 percent phosphoric acid, and 10 percent potash.

2.3 WEED AND INSECT TREATMENT

- A. Provide acceptable treatment to protect sod from weed and insect infestation. Submit treatment method to Owner's Representative for approval. Install insect and disease control within guidelines set forth by Structural Pest Control Board of the State of Texas.

2.4 WATER

- A. Potable, available on-site through Contractor's water trucks. Contractor may use public water when water use is measured through Contractor's meter. Do not use private resident's water.

2.5 BANK SAND

- A. Free of clay lumps, roots, grass, salt, or other foreign material.

PART 3 EXECUTION

3.1 PREPARATION

- A. Verify that soil placement and compaction have been satisfactorily completed. Verify that soil is within allowable range of moisture content.
- B. Topsoil shall be free of weeds and foreign material immediately before sodding.
- C. Do not start work until conditions are satisfactory. Do not start work during inclement or impending inclement weather.
- D. Rake areas to be sodded smooth, free from unsightly variations, bumps, ridges, or depressions.
- E. Spread 2-inch layer of bank sand over areas to be sodded prior to planting of sod.
- F. Apply fertilizer at rate of 25 pounds per 1000 square feet. Apply after raking soil surface and not more than 48 hours prior to laying sod. Mix thoroughly into upper 2 inches of soil. Lightly water to aid in dissipation of fertilizer.

3.2 APPLICATION

- A. Full Sodding: Lay sod with closely fitted joints leaving no voids and with ends of sod strips staggered. Lay sod within 24 hours of harvesting.
- B. On slopes 2:1 and steeper, lay sod perpendicular to slope and secure every row with wooden pegs at maximum 2 feet on center. Drive pegs flush with soil portion of sod.
- C. Prior to placing sod, on slopes 3:1 or where indicated, place Hold/Gro or Roll Lite or equal over topsoil. Securely anchor in place with posts sunk firmly into ground at maximum 16 feet on center along pitch of slope and equal to width of wire mesh horizontally across slopes.
- D. After sod is laid, irrigate thoroughly to secure 6-inch minimum penetration into soil below sod.
- E. Tamp and roll sod with approved equipment to eliminate minor irregularities and to form close contact with soil bed immediately after planting and watering. Submit type of tamping and rolling equipment to be used to Owner's Representative for approval, prior to construction.

3.3 MAINTENANCE

- A. Watering:
 - 1. Water lawn areas once a day with minimum 1/2 inch water for first 3 weeks after area is sodded.
 - 2. After 3-week period, water twice a week with 3/4 inch of water each time unless comparable amount has been provided by rain.
 - 3. Make weekly inspections to determine moisture content of soil unless soil is in frozen condition.
 - 4. Water in afternoon or at night to enable soil to absorb maximum amount of water with minimum evaporation.
- B. Mowing:
 - 1. Mow sod at intervals which will keep grass height from exceeding 3 1/2 inches.
 - 2. Set mower blades at 2 1/2 inches.
 - 3. Do not remove more than one-half of grass leaf surface.
 - 4. Mow sodded areas requiring mowing within 1 month after installation with light-weight rotary type mower. Mow sod only when dry and not in saturated or soft condition.
 - 5. Remove grass clippings during or immediately after mowing.
- C. Fertilizer and Pest Control:
 - 1. Evenly spread fertilizer composite at rate of 40 pounds per 5000 square feet or as recommended by manufacturer. Do not place fertilizer until 2 weeks after placement of sod.
 - 2. Restore bare or thin areas by topdressing with mix of 50 percent sharp sand and 50 percent sphagnum peat moss.
 - 3. Apply mixture 1/4 to 1/2 inch thick.
 - 4. Treat areas of heavy weed and insect infestation as recommended by treatment manufacturer.
- D. Restrict all traffic from sodded areas until sod is established or for minimum 10 days during growing season. Use wood lath and plastic tape to cordon sodded areas. Maintain tape and lath throughout for minimum 30 days during growing season.

3.4 CLEANUP

- A. During course of planting, remove excess and waste materials; keep lawn areas clean and take precautions to avoid damage to existing structures, plants, grass, and streets.
- B. Remove barriers, signs, and other Contractor material and equipment from project site at termination of establishment period.
- C. Dispose of unused materials and rubbish in accordance with Division 1.

END OF SECTION

SECTION 33 05 13 – MANHOLES AND STRUCTURES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Precast concrete manholes for sanitary sewers, storm sewers, and water lines.
- B. Precast concrete sanitary sewer manholes with PVC liner where corrosion resistant manholes.
- C. Pile-supported concrete foundation used for unstable subgrade treatment for manhole base.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices
 - 1. Payment for normal depth manholes, up to 8 feet deep, is on a unit price basis for each manhole installed. Manhole depth is measured from top of cover to sewer invert. Air release manhole depth is measured from top of cover to inside base for air release or vacuum release manholes.
 - 2. Payment for shallow depth manholes is on a unit price basis for each manhole installed. Shallow manholes have a depth of 5 feet or less measured from top of cover to sewer invert.
 - 3. Payment for extra depth manholes is on a unit price basis per vertical foot for each foot of depth greater than 8 feet. Sewer manhole depth is measured from top of cover to sewer invert.
 - 4. No separate payment for internal or external manhole drops.
 - 5. Payment for pile-supported concrete foundation used for unstable subgrade treatment for manhole base is on a unit price basis for each foundation installed.
 - 6. Refer to the provisions of Division 1 for unit price procedures.
- B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for Work in this Section is included in total Stipulated Price.

1.3 REFERENCES

- A. ASME B 16.1 -Cast Iron Pipe Flanges and Flanged Fittings
- B. ASTM A 307 -Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile
- C. ASTM A 615 -Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
- D. ASTM C 270-Standard Specification for Mortar for Unit Masonry
- E. ASTM C 443 -Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
- F. ASTM C 478 -Standard Specification for Precast Reinforced Concrete Manhole Sections
- G. ASTM C 923 -Standard Specifications for Resilient Connectors Between Reinforced Concrete Manhole Structures and Pipes
- H. ASTM C 1107 -Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink)

- I. ASTM D 698 -Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/fr')
- J. ASTM D 2665 -Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste and Vent Pipe and Fittings
- K. ASTM D 2996 -Standard Specification for Filament-Wound "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe.
- L. ASTM D 2997 -Standard Specification for Centrifugally Cast "Fiberglass" (Glass-Fiber-Reinforced Thermosetting Resin) Pipe
- M. AWWA C 213 -Standard for Fusion Bonded Epoxy Coating for Interior and Exterior of Steel Water Pipelines
- N. American Association of State Highway and Transportation Officials (AASHTO)

1.4 SUBMITTALS

- A. Conform to requirements of Division 1.
- B. Submit manufacturer's data and details of following items for approval:
 - 1. Shop drawings of manhole sections, base units and construction details, including reinforcement, jointing methods, materials and dimensions.
 - 2. Summary of criteria used in manhole design including, as minimum, material properties, loadings, load combinations, and dimensions assumed. Include certification from manufacturer that precast manhole design is in full accordance with ASTM C 478 and design criteria as established in Paragraph 2.01E of this Specification.
 - 3. Frames, grates, rings, and covers
 - 4. Materials to be used in fabricating drop connections
 - 5. Materials to be used for pipe connections at manhole walls
 - 6. Materials to be used for stubs and stub plugs, if required
 - 7. Materials and procedures for corrosion-resistant liner and coatings, if required.
 - 8. Plugs to be used for sanitary sewer hydrostatic testing
 - 9. Manufacturer's data for pre-mix (bag) concrete, if used for channel inverts and benches
- C. Seal submittal drawings by Professional Engineer registered in State of Texas.

PART 2 PRODUCTS

2.1 PRECAST CONCRETE MANHOLES

- A. Provide manhole sections, base sections, and related components conforming to ASTM C 478. Provide base riser section with integral floors, unless shown otherwise. Provide adjustment rings which are standard components of manufacturer of manhole sections. Mark date of manufacture and name or trademark of manufacturer on inside of barrel.
- B. Construct barrels for precast manholes from standard reinforced concrete manhole sections of diameter indicated on Drawings. Use various lengths of manhole sections in combination to provide correct height with fewest joints. Design wall sections for depth and loading

conditions in Paragraph 2.01 E, with minimum thickness of 5 inches. Base section shall have minimum thickness of 12 inches under invert.

- C. Provide tops to support HS-20 vehicle loading, and receive cast iron frame covers, as indicated on Drawings.
- D. Where manholes larger than 48-inch diameter are indicated on Drawings, provide precast base sections with flat slab top precast sections used to transition to 48-inch diameter manhole access riser sections. Transition can be concentric or eccentric unless otherwise shown on Drawings. Locate transition to provide minimum of 7-foot head clearance from base to underside of transition unless otherwise approved by Owner's Representative.
- E. Design Loading Criteria: Manhole walls, transition slabs, cone tops, and manhole base slab shall be designed, by manufacturer, to requirements of ASTM C 478 for depth as shown on Drawings and to resist following loads.
 - 1. AASHTO HS-20 vehicle loading applied to manhole cover and transmitted down to transition and base slabs
 - 2. Unit soil weight of 120 pcf located above portions of manhole, including base slab projections
 - 3. Lateral soil pressure based on saturated soil conditions producing an at-rest equivalent fluid pressure of 100 pcf
 - 4. Internal liquid pressure based on unit weight of 63 pcf
 - 5. Dead load of manhole sections fully supported by transition and base slabs
- F. Design: Manhole walls, transition slabs, cone tops, and manhole base slab shall be designed according to requirements of ASTM C 478 and following:
 - 1. Design additional reinforcing steel to transfer stresses at openings. Area of steel to be no less than shown on Drawings.
 - 2. Wall loading conditions:
 - a. Saturated soil pressure acting on empty manhole
 - b. Manhole filled with liquid to a halfway depth as measured from invert to cover, with no balancing external soil pressure
 - 3. Minimum clear distance between two wall penetrations shall be 12 inches or half diameter of smaller penetration, whichever is greater
- G. Provide joints between sections with o-ring gaskets conforming to ASTM C 443.
- H. When base is cast monolithic with portion of vertical section, extend reinforcing in vertical section into base.
- I. Precast Concrete Base: Suitable cutouts or holes to receive pipe and connections. Lowest edge of holes or cutouts: For water line manhole, no less than 6 inches above inside surface of floor of base.

2.2 CONCRETE

- A. Conform to requirements of Division 32.
- B. Channel Inverts: Use 5 sack premix (bag) concrete or Class A concrete for inverts not integrally formed with manhole base, with minimum compressive strength of 4000 psi.
- C. Cement Stabilized Sand Foundation: Provide cement stabilized sand foundation under base section in lieu of foundation slab, as shown on Drawings, conforming to requirements of Division 31.

- D. Concrete Foundation: Provide Class A concrete with minimum compressive strength of 4000 psi for concrete foundation slab under manhole base section where indicated on Drawings.

2.3 REINFORCING STEEL

- A. Conform to requirements of Division 32.

2.4 MORTAR

- A. Conform to requirements of City of Houston Standard Specifications Section 04061 – Mortar.

2.5 MISCELLANEOUS METALS

- A. Provide cast-iron frames, rings, and covers conforming to requirements of Division 33.

2.6 DROP CONNECTIONS AND STUBS

- A. Provide drop connections and stubs conforming to same pipe material requirements used in main pipe, unless otherwise indicated on Drawings.

2.7 PIPE CONNECTIONS TO MANHOLE

- A. Sanitary Sewers.

1. Provide resilient connectors conforming to requirements of ASTM C 923. Use the following materials for metallic mechanical devices as defined in ASTM C 923:
 - a. External clamps: Type 304 stainless steel
 - b. Internal, expandable clamps on standard manholes: Type 304 stainless steel, 11 gauge minimum.
 - c. Internal, expandable clamps on corrosion-resistant manholes:
 - 1) Type 316 stainless steel, 11 gauge minimum
 - 2) Type 304 stainless steel, 11 gauge minimum, coated with minimum 16 mil fusion-bonded epoxy conforming to AWWA C 213
2. Where rigid joints between pipe and cast-in-place manhole base are specified or shown on Drawings, provide polyethylene-isoprene water-stop meeting physical property requirements of ASTM C 923, such as Press-Seal WS Series, or approved equal.

- B. Storm Sewer Connections:

1. Provide watertight connections in accordance with ASTM C 923.

- C. Water Lines

1. Where smooth exterior pipes, i.e., steel, ductile iron, or PVC pipes are connected to manhole base or barrel, seal space between pipe and manhole wall with assembly consisting of rubber gasket or links mechanically compressed to form a watertight barrier. Assemblies: Press-Wedge, Res-Seal, Thunderline Link-Seal, or approved equal. See Drawings for placement of assembly in manhole sections.
2. When connecting concrete or cement mortar coated steel pipes, or as option for connecting smooth exterior pipes to manhole base or barrel, space between pipe and manhole wall may be sealed with an assembly consisting of a stainless steel power sleeve, stainless steel take-up clamp and a rubber gasket. Take-up clamp: Minimum of 9/16 inch wide. Provide PSX positive seal gasket system by Press-Seal Gasket Corporation or approved equal.

2.8 SEALANT MATERIALS

- A. Provide sealing materials between precast concrete adjustment ring and manhole cover frame, Adeka Ultraseal P201, or approved equal.
- B. Provide approved external sealing material from Canusa Wrapid Seal manhole encapsulation system or approved equal.
- C. Provide Butyl Sealant: Provide Press-Seal EZ Stick, or equal, for HDPE rings.

2.9 CORROSION RESISTANT MANHOLE MATERIALS

- A. Where corrosion-resistant manholes or PVC-lined manholes are indicated on Drawings, provide one of following:
 - 1. PVC liner for precast cylindrical manhole section, base sections, and cone sections in accordance with Division 33.
 - 2. Precast base sections, as specified above, lined with PVC or equal and fiberglass manholes in accordance with Division 33.

2.10 BACKFILL MATERIALS

- A. Conform to requirements of Division 31.

2.11 NON-SHRINK GROUT

- A. Provide prepackaged, inorganic, flowable, non-gas-liberating, non-metallic, cement-based grout requiring only addition of water.
- B. Meet requirements of ASTM C 1107 and have minimum 28-day compressive strength of 7000 psi.

2.12 VENT PIPES

- A. Provide external vent pipes for manholes where indicated on Drawings.
- B. Buried Vent Pipes: Provide 3 inch or 4 inch PVC DWV pipe conforming to ASTM D 2665. Alternatively, provide FRP pipe as specified for vent outlet assembly.
- C. Vent Outlet Assembly: Provide vent outlet assembly as shown on Drawings, constructed of following specified materials:
 - 1. FRP Pipe: Provide filament wound FRP conforming to ASTM D 2996 or centrifugally cast FRP conforming to ASTM D 2997. Seal cut ends in accordance with manufacturer's recommendations.
 - 2. Joints and Fittings: Provide epoxy bodied fittings and join pipe to fittings with epoxy adhesive
 - 3. Flanges: Provide socket-flange fittings for epoxy adhesive bonding to pipe ends where shown on Drawings. Meet bolt pattern and dimensions for ASME B 16.1, 125-pound flanges. Flange bolts shall be Type 304 stainless steel or hot-dip zinc coated, conforming to ASTM A 307, Class A or B.
 - 4. Coating: Provide approved 2-component, aliphatic polyurethane coating using primer or tie coat recommended by manufacturer. Provide two or more coats to yield dry film thickness of at least 3 mils. Color shall be selected by The Engineer from manufacturer's standard colors.

2.13 PROHIBITED MATERIALS

- A. Do not use brick masonry for construction of manholes, including adjustment of manholes to grade unless approved by the Engineer. Use only specified materials listed above.

2.14 MANHOLE LADDER FOR WATERLINE MANHOLES

- A. Manhole Ladder: Fiberglass with 300-lb rating at appropriate length; conform to requirements of Occupational Safety and Health Standards (OSHA), U.S. Department of Labor except where shown on Drawings.
 - 1. Use components, including rungs, made of fiberglass, fabricated with nylon or aluminum rivets and/or epoxy. Apply non-skid coating to ladder rungs. Mount ladder using manufacturer's recommended hardware.
 - 2. Provide ladder as manufactured by Saf-Rail or approved equal. Locate ladder as shown on Drawings.
 - 3. Fiberglass: Premium type polyester resin, reinforced with fiberglass; constructed to provide complete wetting of glass by resin; resistant to rot, fungi, bacterial growth and adverse effects of acids, alkalis, and residential and industrial waste; yellow in color.
 - 4. Provide approved petroleum-based tape encapsulating bolts in access manhole.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that lines and grades are correct.
- B. Determine if subgrade, when scarified and recompact, can be compacted to 95 percent of maximum Standard Proctor Density according to ASTM D 698 prior to placement of foundation material and base section. When proper density is not reached, moisture condition subgrade until that density is reached or treat as unstable subgrade.
- C. Do not build manholes in ditches, swales, or drainage paths unless approved by the Engineer.

3.2 PLACEMENT

- A. Install precast manholes to conform to locations and dimensions shown on Drawings.
- B. Place sanitary and storm manholes at points of change in alignment, grade, size, pipe intersections, and end of sewer unless otherwise shown on Drawings.

3.3 MANHOLE BASE SECTIONS AND FOUNDATIONS

- A. Place precast base on 12 inch thick (minimum) foundation of crushed stone wrapped in filter fabric, cement stabilized sand, or concrete foundation slab. Compact cement-sand in accordance with requirements of Division 2.
- B. Unstable Subgrade Treatment: When unstable subgrade is encountered, notify the Engineer for examination of subgrade to determine if subgrade has heaved upwards after being excavated. When heaving has not occurred, over-excavate subgrade to allow for 24 inch-thick layer of crushed stone wrapped in filter fabric as foundation material under manhole base. When there is evidence of heaving, provide pile-supported concrete foundation, as detailed on Drawings, under manhole base.

3.4 PRECAST MANHOLE SECTIONS

- A. Install sections, joints, and gaskets in accordance with manufacturer's printed recommendations.
- B. Install precast adjustment rings above tops of cones or flat-top sections as required to adjust finished elevation and to support manhole frame.
- C. Seal any lifting holes with non-shrink grout.
- D. Where PVC liners are required, seal joints between sections in accordance with manufacturer's recommendations.
- E. Place at least two precast concrete grade rings with thickness of 12 inches or less, under casting.

3.5 PIPE CONNECTIONS AT MANHOLES

- A. Install approved resilient connectors at each pipe entering and exiting manholes in accordance with manufacturer's instructions.
 - 1. Where smooth exterior pipes, i.e. steel, ductile iron or PVC pipes are connected to manhole base or barrel, space between pipe and manhole wall shall be sealed with an assembly consisting of rubber gaskets or links mechanically compressed to form watertight barrier. Assemblies: "Press-Wedge," "Res-Seal," "Thunderline Link-Seals," or approved equal. See Drawings for placement of assembly in manhole sections.
 - 2. When connecting concrete or cement mortar coated steel pipes, or as an option for connecting smooth exterior pipes to manhole base or barrel, space between pipe and manhole wall may be sealed with an assembly consisting of stainless steel power sleeve, stainless steel take-up clamp and rubber gasket. Take-up clamp: Minimum of 9/16 inch wide. Provide PSX positive seal gasket system by Press-Seal Gasket Corporation or approved equal.
- B. Grout storm sewer connections to manhole unless otherwise shown on Drawings. Grout pipe penetration in place on both inside and outside of manhole.
- C. Ensure no concrete, cement stabilized sand, fill, or other rigid material is allowed to enter space between pipe and edge of wall opening at and around resilient connector on either interior or exterior of manhole. If necessary, fill space with compressible material to ensure full flexibility provided by resilient connector.
- D. Where new manhole is constructed on existing sewer, rigid joint pipe may be used. Install waterstop gasket around existing pipe at center of cast-in-place wall. Join ends of split waterstop material at pipe springline using an adhesive recommended and supplied by waterstop manufacturer.
- E. Test connection for watertight seal before backfilling.

3.6 INVERTS FOR SANITARY SEWERS

- A. Construct invert channels to provide smooth flow transition waterway with no disruption of flow at pipe-manhole connections. Conform to following criteria:
 - 1. Slope of invert bench: 1 inch per foot minimum; 1-1/2 inches per foot maximum

2. Depth of bench to invert:
 - a. Pipes smaller than 15 inches: one-half of largest pipe diameter
 - b. Pipes 15 to 24 inches: three-fourths of largest pipe diameter
 - c. Pipes larger than 24 inches: equal to largest pipe diameter
 3. Invert slope through manhole: 0.10 foot drop across manhole with smooth transition of invert through manhole, unless otherwise indicated on Drawings.
- B. Form invert channels with concrete if not integral with manhole base section. For direction changes of mains, construct channels tangent to mains with maximum possible radius of curvature. Provide curves for side inlets and smooth invert fillets for flow transition between pipe inverts.

3.7 DROP CONNECTIONS FOR SANITARY SEWERS

- A. Backfill drop assembly with crushed stone wrapped in filter fabric, cement stabilized sand, or Class A concrete to form solid mass. Extend cement stabilized sand or concrete encasement minimum of four (4) inches outside bells.
- B. Install drop connection when sewer line enters manhole higher than 30 inches above invert of manhole.

3.8 STUBS FOR FUTURE CONNECTIONS

- A. In manholes, where future connections are indicated on Drawings, install resilient connectors and pipe stubs with approved watertight plugs.

3.9 MANHOLE FRAME AND ADJUSTMENT RINGS

- A. Combine precast concrete adjustment rings so elevation of installed casting cover matches pavement surface. Seal between concrete adjustment ring and precast top section with non-shrink grout; do not use mortar between adjustment rings. Apply latex-based bonding agent to precast concrete surfaces joined with non-shrink grout. Set cast iron frame on adjustment ring in bed of approved sealant material. Install sealant bed consisting of two beads of sealant, each bead having minimum dimensions of 1/2-inch and 1/2-inch wide.
- B. Wrap manhole frame and adjustment rings with external sealing material, minimum 3 inches beyond joint between ring and frame and adjustment rings and precast section.
- C. For manholes in unpaved areas, set top of frame minimum of 6 inches above existing ground line unless otherwise indicated on Drawings. In unpaved areas, encase manhole frame in mortar or non-shrink grout placed flush with face of manhole ring and top edge of frame. Provide rounded corner around perimeter.

3.10 BACKFILL

- A. Place and compact backfill materials in area of excavation surrounding manholes in accordance with requirements of Division 31. Provide embedment zone backfill material, as specified for adjacent utilities, from manhole foundation up to an elevation 12 inches over each pipe connected to manhole. Provide trench zone backfill, as specified for adjacent utilities, above embedment zone backfill.
- B. Where rigid joints are used for connecting existing sewers to manhole, backfill under existing sewer up to springline of pipe with Class B concrete or flowable fill.

- C. In unpaved areas, provide positive drainage away from manhole frame to natural grade. Provide minimum of 4 inches of topsoil conforming to requirements of Division 32. When shown on Drawings, sod disturbed areas in accordance with Division 32.

3.11 FIELD QUALITY CONTROL

- A. Conduct leakage testing of sanitary sewer manholes in accordance with requirements of Division 33.

3.12 PROTECTION

- A. Protect manholes from damage until work has been accepted. Repair damage to manholes at no additional cost to the Owner.

END OF SECTION

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SECTION 33 05 13.13 – MANHOLES GRADE ADJUSTMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Adjusting elevation of manholes, inlets, and valve boxes to new grades.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices.
 - 1. No separate payment will be made for adjusting inlets and valve boxes to grade for new construction under this Section. Include payment in unit price for related item.
 - 2. Payment for adjusting existing manhole and frame and cover to new grade is on a unit price basis for each manhole and frame and cover.
 - 3. Payment for adjusting existing utility structures to grade is on unit price basis for each:
 - a. Inlet adjusted
 - b. Valve box adjusted
 - c. Refer to Division 1 for unit price procedures.
- B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for Work in this Section is included in total Stipulated Price.

PART 2 PRODUCTS

2.1 CONCRETE MATERIALS

- A. Provide concrete, conforming to requirements of Division 33.
- B. Provide precast concrete manhole sections and adjustment rings conforming to requirements of Division 33.
- C. Provide mortar conforming to requirements of City of Houston Standard Specifications Section 04016 - Mortar.

2.2 CAST-IRON MATERIALS

- A. Provide cast-iron materials conforming to requirements of Division 33.

2.3 PIPING MATERIALS

- A. For riser pipes and fittings, refer to Division 33.

2.4 MASONRY MATERIALS FOR STORM SEWER MANHOLES AND INLETS

- A. Provide brick masonry units conforming to the requirements of Division 32.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine existing structure, valve box, frame and cover or inlet box, frame and cover or inlet, piping and connections for damage or defects affecting adjustment to grade. Report damage or defects to Project Manger.

3.2 ESTABLISHING GRADE

- A. Coordinate grade related items with existing grade and finished grade or paving, and relate to established bench mark or reference line.

3.3 ADJUSTING MANHOLES AND INLETS

- A. Rebuild adjustment portion of manhole or inlet by adding or removing Adjustments. Follow procedures for the type of structure being adjusted detailed in Division 33.
- B. Salvage and reuse cast-iron frame and cover or grate.
- C. Protect or block off manhole or inlet bottom using wood forms shaped to fit so that no debris or soil falls to bottom during adjustment.
- D. Verify that manholes and inlets are free of visible leaks as result of reconstruction. Repair leaks in manner subject to Project Manger's approval.

3.4 ADJUSTING VALVE BOXES

- A. Salvage and reuse valve box and surrounding concrete block as approved by Project Manger. No separate pay.
- B. Remove and replace 6 inch ductile iron riser pipe with suitable length for depth of cover required to establish adjusted elevation to accommodate actual finish grade.
- C. Reinstall valve box and riser piping plumbed in vertical position. Provide minimum 6 inches telescoping freeboard space between riser pipe top butt end and interior contact flange of valve box for vertical movement damping.
- D. After valve box has been set, aligned, and adjusted so that top lid is level with final grade.

3.5 BACKFILL AND GRADING

- A. Backfill area of excavation surrounding each adjusted manhole, inlet, and valve box and compact according to requirements of Division 31.
- B. Grade ground surface to drain away from each manhole and valve box. Place earth fill around manholes to level of upper rim of manhole frame. Place earth fill around valve box concrete slab.
- C. In unpaved areas, grade surface at uniform slope of 1 to 5 from manhole frame to natural grade. Provide minimum of 4 inches of topsoil conforming to requirements of Division 32.

END OF SECTION

SECTION 33 05 16.13 - PRECAST CONCRETE UTILITY STRUCTURES

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Precast concrete inlets for storm or sanitary sewers, including cast iron frame and plate or grate.
- B. Precast concrete headwalls and wingwalls for storm sewers.
- C. Precast junction box with lid or grate top.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices:
 - 1. Payment for precast concrete utility structure is on a unit price basis for each structure installed.
- B. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 REFERENCES

- A. ASTM C 76 - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.

1.4 SUBMITTALS

- A. Conform to requirements of Division 1.
- B. Submit shop drawings for approval of design and construction details for precast concrete inlets, junction box headwalls, and wingwalls. Precast units differing from standard designs shown on Drawings will be rejected unless shop drawing submittals are approved. Clearly show proposed substitution is equal or superior in every aspect to standard designs.
- C. Submit manufacturers' data and details for frames, grates, rings, and covers.

1.5 STORAGE AND SHIPMENT

- A. Store precast units on level blocking. Do not place loads until design strength is reached. Shipment of acceptable units may be made when 28-day strength requirements have been met.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Concrete: Provide concrete for precast machine-made units meeting requirements of ASTM C 76 regarding reinforced concrete, cement, aggregate, mixture, and concrete test. Minimum 28-day compressive strength shall be 4,000 psi.

- B. Reinforcing Steel: Place reinforcing steel to conform to details shown on Drawings and as follows:
 - 1. Provide positive means for holding steel cages in place throughout production of concrete units. Maximum variation in reinforcement position is plus or minus 10 percent of wall thickness or plus or minus 1/2 inch, whichever is less. Regardless of variation, maintain minimum cover of concrete over reinforcement as shown on Drawings.
 - 2. Welding of reinforcing steel is not permitted unless noted on Drawings.
- C. Mortar and Hydraulic Cement: Conform to requirements of Division 32.
- D. Miscellaneous Metal: Cast-iron frames and plates conforming to requirements of Division 33.

2.2 SOURCE QUALITY CONTROL

- A. Tolerances: Allowable casting tolerances for concrete units are plus or minus 1/4 inch from dimensions shown on Drawings. Concrete thickness in excess of that required will not constitute cause for rejection provided that excess thickness does not interfere with proper jointing operations.
- B. Precast Unit Identification: Mark date of manufacture and name or trademark of manufacturer clearly on inside of inlet, headwall, or wingwall.
- C. Rejection: Precast units rejected for non-conformity with these specifications and for following reasons:
 - 1. Fractures or cracks passing through shell, except for single end crack that does not exceed depth of joint.
 - 2. Surface defects indicating honeycombed or open texture.
 - 3. Damaged or misshaped ends, where damage would prevent making satisfactory joint.
- D. Replacement: Immediately remove rejected units from Work site and replace with acceptable units.
- E. Repairs: Occasional imperfections resulting from manufacture or accidental damage may be repaired if, in opinion of Owner's Representative, repaired units conform to requirements of these specifications.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify lines and grades are correct.
- B. Verify compacted subgrade will support loads imposed by inlets.

3.2 INSTALLATION

- A. Install units complete in place to dimensions, lines, and grades as shown on Drawings.
- B. Excavate in accordance with requirements of Division 31.
- C. Bed precast concrete units on foundations of firm, stable material shaped to conform to shape of unit bases.

- D. Provide adequate means to lift and place concrete units.

3.3 FINISHES

- A. Use hydraulic cement to seal joints, fill lifting holes and as otherwise required.
- B. When box section of inlet has been completed, shape floor of inlet with mortar to conform to Drawing details.
- C. Adjust cast iron inlet plate frames to line, grade, and slope shown on Drawings. Grout frame in place with mortar.

3.4 INLET WATERTIGHTNESS

- A. Verify that inlets are free of leaks. Repair leaks in approved manner.

3.5 CONNECTIONS

- A. Connect storm sewer leads to inlets as shown on Drawings. Seal connections inside and outside with hydraulic cement. Make connections watertight.

3.6 BACKFILL

- A. Backfill area of excavation surrounding each completed inlet, headwall, or wingwall according to requirements of Division 31.

END OF SECTION

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SECTION 33 05 16.16 - CONCRETE FOR UTILITY CONSTRUCTION

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Cast-in-place concrete work for utility construction or rehabilitation, such as slabs on grade, small vaults, site-cast bases for precast units, and in-place liners for manhole rehabilitation.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices:
 - 1. No payment will be made for concrete for utility construction under this Section unless specifically noted in bid documents. Include cost in, unit price for appropriate Work item.
- B. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 REFERENCES

- A. ACI 117 - Standard Tolerances for Concrete Construction and Materials.
- B. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete.
- C. ACI 302.1R - Guide for Concrete Floor and Slab Construction.
- D. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete.
- E. ACI 308 - Standard Practice for Curing Concrete.
- F. ACI 309R - Guide for Consolidation of Concrete.
- G. ACI 311 - Guide for Concrete Plant Inspection and Field Testing of Ready-Mix Concrete.
- H. ACI 315 - Details and Detailing of Concrete Reinforcement.
- I. ACI 318 - Building Code Requirements for Reinforced Concrete and Commentary.
- J. ACI 544 - Guide for Specifying, Mixing, Placing, and Finishing Steel Fiber Reinforced Concrete.
- K. ASTM A 82 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
- L. ASTM A 185 - Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.
- M. ASTM A 615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
- N. ASTM A 767 - Standard Specifications for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement.

- O. ASTM A 775 - Standard Specification for Epoxy-Coated Reinforcing Steel Bars.
- P. ASTM A 820 - Standard Specification for Steel Fibers for Fiber-Reinforced Concrete.
- Q. ASTM A 884 - Specification for Epoxy-Coated Steel Wire and Welded Wire Fabric for Reinforcement.
- R. ASTM C 31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
- S. ASTM C 33 - Standard Specification for Concrete Aggregates.
- T. ASTM C 39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
- U. ASTM C 42 - Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
- V. ASTM C 94 - Standard Specification for Ready-Mixed Concrete.
- W. ASTM C 138 - Standard Test Method for Unit Weight Yield and Air Content (Gravimetric) of Concrete.
- X. ASTM C 143 - Standard Test Method for Slump of Hydraulic Cement Concrete.
- Y. ASTM C 150 - Standard Specification for Portland Cement.
- Z. ASTM C 172 - Standard Practice for Sampling Freshly Mixed Concrete.
- AA. ASTM C 173 - Standard Test Method for Air Content of Freshly Mixed Concrete by Volumetric Method.
- BB. ASTM C 231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
- CC. ASTM C 260 - Standard Specification for Air-Entraining Admixtures for Concrete.
- DD. ASTM C 309 - Standard Specifications for Liquid Membrane-Forming Compounds for Curing Concrete.
- EE. ASTM C 494 - Standard Specification for Chemical Admixtures for Concrete.
- FF. ASTM C 595 - Standard Specification for Blended Hydraulic Cements.
- GG. ASTM C 685 - Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing.
- HH. ASTM C 1064 - Standard Test Method for Temperature of Freshly Mixed Portland Cement Concrete.
- II. ASTM C 1077 - Standard Practice for Laboratory Testing of Concrete and Concrete Aggregate for Use in Construction and Criteria for Laboratory Evaluation.
- JJ. CRSI MSP-1 - Manual of Standard Practice.
- KK. CRSI - Placing Reinforcing Bars.

LL. Federal Specification SS-S-210A - Sealing Compound, Preformed Plastic, for Expansion Joints and Pipe Joints

MM. NRMCA - Concrete Plant Standards.

1.4 SUBMITTALS

- A. Conform to requirements of Division 1.
- B. Submit proposed mix design and test data for each type and strength of concrete in Work.
- C. Submit laboratory reports prepared by independent testing laboratory stating that materials used comply with requirements of this Section.
- D. Submit manufacturer's mill certificates for reinforcing steel. Provide specimens for testing when required by Owner's Representative.
- E. Submit certification from concrete supplier that materials and equipment used to produce and deliver concrete comply with this Specification.
- F. When required on Drawings, submit shop drawings showing reinforcement type, quantity, size, length, location, spacing, bending, splicing, support, fabrication details, and other pertinent information.
- G. For waterstops, submit product information sufficient to indicate compliance with this Section, including manufacturer's descriptive literature and specifications.

1.5 HANDLING AND STORAGE

- A. Cement: Store cement off of ground in well-ventilated, weatherproof building.
- B. Aggregate: Prevent mixture of foreign materials with aggregate and preserve gradation of aggregate.
- C. Reinforcing Steel: Store reinforcing steel to protect it from mechanical injury and formation of rust. Protect epoxy-coated steel from damage to coating.

PART 2 PRODUCTS

2.1 CONCRETE MATERIALS

- A. Cementitious Material:
 - 1. Portland Cement: ASTM C 150, Type II, unless use of Type III is authorized by Owner's Representative; or ASTM C 595, Type IP. For concrete in contact with sewage use Type II cement.
 - 2. When aggregates are potentially reactive with alkalis in cement, use cement not exceeding 0.6 percent alkali content in form of $\text{Na}_2\text{O} + 0.658\text{K}_2\text{O}$.
- B. Water: Clean, free from harmful amounts of oils, acids, alkalis, or other deleterious substances, and meeting requirements of ASTM C 94.
- C. Fiber:
 - 1. Fibrillated Polypropylene Fiber:
 - a. Addition Rate: 1.5 pounds of fiber per cubic yard of concrete.

- b. Physical Properties:
 - 1) Material: Polypropylene
 - 2) Length: 1/2 inch or graded
 - 3) Specific Gravity: 0.9l
 - c. Acceptable Manufacturer: W. R. Grace Company, Fibermesh, or approved equal.
2. Steel Fiber: Comply with applicable provisions of ACI 544 and ASTM A 820.
- a. Ratio: 50 to 200 pounds of fiber per cubic yard of concrete.
 - b. Physical Properties:
 - 1) Material: Steel
 - 2) Aspect Ratio (for fiber lengths of 0.5 to 2.5 inch, length divided by diameter or equivalent diameter): 30:1 to 100:1
 - 3) Specific Gravity: 7.8
 - 4) Tensile Strength: 40-400 ksi.
 - 5) Young's Modulus: 29,000 ksi
 - 6) Minimum Average Tensile Strength: 50,000 psi
 - 7) Bending Requirements: Withstand bending around 0.125-inch diameter mandrel to angle of 90 degrees, at temperatures not less than 60 degrees F, without breaking
- D. Curing Compounds: Type 2 white-pigmented liquid membrane-forming compounds conforming to ASTM C 309.

2.2 FORM WORK MATERIALS

- A. Lumber and Plywood: Seasoned and of good quality, free from loose or unsound knots, knot holes, twists, shakes, decay and other imperfections which would affect strength or impair finished surface of concrete. Use S4S lumber for facing or sheathing. Forms for bottoms of caps: At least 2 inch (nominal) lumber or 3/4 inch form plywood backed adequately to prevent misalignment. For general use, provide lumber of 1-inch nominal thickness or form plywood of approved thickness.
- B. Form work for Exposed Concrete Indicated to Receive Rubbed Finish: Form or form-lining surfaces free of irregularities; plywood of 1/4 inch minimum thickness, preferably oiled at mill.
- C. Chamfer Strips and Similar Moldings: Redwood, cypress, or pine that will not split when nailed and which can be maintained to true line. Use mill-cut molding dressed on all faces.
- D. Form Ties: Metal or fiberglass of approved type with tie holes not larger than 7/8 inch in diameter. Do not use wire ties or snap ties.
- E. Metal Forms: Clean and in good condition, free from dents and rust, grease, or other foreign materials that tend to disfigure or discolor concrete in gauge and condition capable of supporting concrete and construction loads without significant distortion. Countersink bolt and rivet heads on facing sides. Use only metal forms which present smooth surface and which line up properly.

2.3 PRODUCTION METHODS

- A. Use either ready-mixed concrete conforming to requirements of ASTM C 94, or concrete produced by volumetric batching and continuous mixing in accordance with ASTM C 685.

2.4 MEASUREMENT OF MATERIALS

- A. Measure dry materials by weight, except volumetric proportioning may be used when concrete is batched and mixed in accordance with ASTM C 685.
- B. Measure water and liquid admixtures by volume.

2.5 DESIGN MIX

- A. Use design mixes prepared by certified testing laboratory in accordance with ASTM C 1077 and conforming to requirements of this section.
- B. Proportion concrete materials based on ACI 211.1 to comply with durability and strength requirements of ACI 318, Chapters 4 and 5, and this specification. Prepare mix design of Class A concrete so minimum cementitious content is 564 pounds per cubic yard. Submit concrete mix designs to Owner's Representative for review.
- C. Proportioning on basis of field experience or trial mixtures in accordance with requirements at Section 5.3 of ACI 318 may be used, when approved by Owner's Representative.

D. Classification:

| Class | Type | Minimum Compressive Strength (LBS/Sq.In.) | | Miximum W/C Ratio | Air Content (Percent) | Consistency Range in Slump (Inches) |
|-------|-------------------------------|---|--------|-------------------|-----------------------|-------------------------------------|
| | | 7-Day | 28-Day | | | |
| A | Structural | 3200 | 4000 | 0.45 | 4 ± 1 | 2 to 4* |
| B | Pipe Block Fill, Thrust Block | --- | 1500 | --- | 4 ± 1 | 5 to 7 |

*When ASTM C 494, Types F or Type G admixture is used to increase workability, this range may be 6 to 9.

- E. Add steel or polypropylene fibers only when called for on Drawings or in another section of these Specifications.
- F. Determine air content in accordance with ASTM C 138, ASTM C 173 or ASTM C 231.
- G. Use of Concrete Classes: Use classes of concrete as indicated on Drawings and other Specifications. Use Class B for unreinforced concrete used for plugging pipes, seal slabs, thrust blocks, trench dams, tunnel inverts and concrete fill unless indicated otherwise. Use Class A for all other applications.

2.6 PVC WATERSTOPS

- A. Extrude from virgin polyvinyl chloride elastomer. Use no reclaimed or scrap material. Submit waterstop manufacturer's current test reports and manufacturer's written certification that material furnished meets or exceeds Corps of Engineers Specification CRD-C572 and other specified requirements.
- B. Flat Strip and Center-Bulb Waterstops:
 - 1. Thickness: not less than 3/8 inch

2. Acceptable Manufacturers:
 - a. Kirkhill Rubber Co., Brea, California
 - b. Water Seals, Inc., Chicago, Illinois
 - c. Progress Unlimited, Inc., New York, New York
 - d. Greenstreak Plastic Products Co., St. Louis, Missouri
 - e. Approved equal.

2.7 RESILIENT WATERSTOP

- A. Resilient Waterstop: Where shown on Drawings; either bentonite- or adhesive-type material.
- B. Bentonite Waterstop:
 1. Material: 75 percent bentonite, mixed with butyl rubber-hydrocarbon containing less than 1.0 percent volatile matter, and free of asbestos fibers or asphaltics.
 2. Manufacturer's rated temperature ranges: For application, 5 to 125 degrees F; in service, -40 to 212 degrees F.
 3. Cross-sectional dimensions, unexpanded waterstop: 1 inch by 3/4 inch
 4. Provide with adhesive backing capable of producing excellent adhesion to concrete surfaces.
- C. Adhesive Waterstop:
 1. Preformed plastic adhesive waterstop at least 2 inches in diameter.
 2. Meets or exceeds requirements of Federal Specification SS-S-210A.
 3. Supplied wrapped completely by 2 part protective paper.
 4. Submit independent laboratory tests verifying that material seals joints in concrete against leakage when subjected to minimum of 30 psi water pressure for at least 72 hours.
 5. Provide primer, to be used on hardened concrete surfaces, from same manufacturer who supplies waterstop material.
 6. Acceptable Manufacturer: Synko-Flex Preformed Plastic Adhesive Waterstop, Synko-Flex Products, Inc.; or approved equal.

PART 3 EXECUTION

3.1 FORMS AND SHORING

- A. Provide mortar-tight forms sufficient in strength to prevent bulging between supports. Set and maintain forms to lines designated such that finished dimensions of structures are within tolerances specified in ACI 117. Construct forms to permit removal without damage to concrete. Forms may be given slight draft to permit ease of removal. Provide adequate clean out openings. Before placing concrete, remove extraneous matter from within forms.
- B. Install rigid shoring having no excessive settlement or deformation. Use sound timber in shoring centering. Shim to adjust and tighten shoring with hardwood timber wedges.
- C. Design Loads for Horizontal Surfaces of Forms and Shoring: Minimum fluid pressure, 175 pounds per cubic foot; live load, 50 pounds per square foot. Maximum unit stresses: 125 percent of allowable stresses used for form materials and for design of support structures.
- D. Back form work with sufficient number of studs and wales to prevent deflection.

- E. Re-oil or lacquer liner on job before using. Facing may be constructed of 3/4 inch plywood made with waterproof adhesive backed by adequate studs and wales. In such cases, form lining will not be required.
- F. Unless otherwise indicated, form outside corners and edges with triangular 3/4 inch chamfer strips (measured on sides).
- G. Remove metal form ties to depth of at least 3/4 inch from surface of concrete. Do not burn off ties. Do not use pipe spreaders. Remove spreaders which are separate from forms as concrete is being placed.
- H. Treat facing of forms with approved form coating before concrete is placed. When directed by Owner's Representative, treat both sides of face forms with coating. Apply coating before reinforcement is placed. Immediately before concrete is placed, wet surface of forms which will come in contact with concrete.

3.2 EMBEDDED ITEMS

- A. Install conduit and piping as shown on Drawings. Accurately locate and securely fasten conduit, piping, and other embedded items in forms.
- B. Install waterstops as specified in other sections and according to manufacturer's instructions. Securely position waterstops at joints as indicated on Drawings. Protect waterstops from damage or displacement during concrete placing operations.

3.3 BATCHING, MIXING AND DELIVERY OF CONCRETE

- A. Measure, batch, mix, and deliver ready-mixed concrete in accordance with ASTM C 94, Sections 8 through 11. Produce ready-mixed concrete using automatic batching system as described in NRMCA Concrete Plant Standards, Part 2 - Plant Control Systems.
- B. Measure, mix and deliver concrete produced by volumetric batching and continuous mixing in accordance with ASTM C 685, Sections 6 through 8.
- C. Maintain concrete workability without segregation of material and excessive bleeding. Obtain approval of Owner's Representative before adjustment and change of mix proportions.
- D. Ready-mixed concrete delivered to site shall be accompanied by batch tickets providing information required by ASTM C 94, Section 16. Concrete produced by continuous mixing shall be accompanied by batch tickets providing information required by ASTM C 685, Section 14.
- E. When adverse weather conditions affect quality of concrete, postpone concrete placement. Do not mix concrete when air temperature is at or below 40 degrees F and falling. Concrete may be mixed with shade, away from artificial heat. Protect concrete from temperatures below 32 degrees F until concrete has cured for minimum of 3 days at 70 degrees F or 5 days at 50 degrees F.
- F. Clean, maintain and operate equipment so that it thoroughly mixes material as required.
- G. Hand-mix only when approved by Owner's Representative.

3.4 PLACING CONCRETE

- A. Give sufficient advance notice to Owner's Representative (at least 24 hours prior to commencement of operations) to permit inspection of forms, reinforcing steel, embedded

items and other preparations for placing concrete. Place no concrete prior to Owner's Representative's approval.

- B. Schedule concrete placing to permit completion of finishing operations in daylight hours. However, when necessary to continue after daylight hours, light site as required. When rainfall occurs after placing operations are started, provide covering to protect work.
- C. Use troughs, pipes and chutes lined with approved metal or synthetic material in placing concrete so that concrete ingredients are not separated. Keep chutes, troughs and pipes clean and free from coatings of hardened concrete. Allow no aluminum material to be in contact with concrete.
- D. Limit free fall of concrete to 4 feet. Do not deposit large quantities of concrete at one location so that running or working concrete along forms is required. Do not jar forms after concrete has taken initial set; do not place strain on projecting reinforcement or anchor bolts.
- E. Use tremies for placing concrete in walls and similar narrow or restricted locations. Use tremies made in sections, or provide in several lengths, so that outlet may be adjusted to proper height during placing operations.
- F. Place concrete in continuous horizontal layers approximately 12 inches thick. Place each layer while layer below is still plastic.
- G. Compact each layer of concrete with concrete spading implements and mechanical vibrators of approved type and adequate number for size of placement. When immersion vibrators cannot be used, use form vibrators. Apply vibrators to concrete immediately after depositing. Move vibrator vertically through layer of concrete just placed and several inches into plastic layer below. Do not penetrate or disturb layers previously placed which have partially set. Do not use vibrators to aid lateral flow concrete. Closely supervise consolidation to ensure uniform insertion and duration of immersion.
- H. Handling and Placing Concrete: Conform to ACI 302.1R, ACI 304R and ACI 309R.

3.5 WATERSTOPS

- A. Embed waterstops in concrete across joints as shown. Waterstops shall be continuous for extent of joint; make splices necessary to provide continuity in accordance with manufacturer's instructions. Support and protect waterstops during construction operations; repair or replace waterstops damaged during construction.
- B. Install waterstops in concrete on one side of joints, leaving other side exposed until next pour. When waterstop will remain exposed for 2 days or more, shade and protect exposed end temperature is 35 degrees waterstop from direct rays of sun during entire exposure and until exposed portion of waterstop is embedded in concrete.

3.6 F and rising. Take temperature readings in

- A. Splicing PVC Waterstops:
 - 1. Splice waterstops by heat-sealing adjacent waterstop sections in accordance with manufacturer's printed instructions.
 - 2. Butt end-to-end joints of two identical waterstop sections may be made in forms during placement of waterstop material.
 - 3. Prior to placement in form work, prefabricate waterstop joints involving more than two ends to be joined together, angle cut, alignment change, or joining of two dissimilar

waterstop sections, allowing not less than 24 inch long strips of waterstop material beyond joint. Upon inspection and approval by Owner's Representative, install prefabricated waterstop joint assemblies in form work, and butt-weld ends of 24 inch strips to straight-run portions of waterstop in forms.

B. Setting PVC Waterstops:

1. Correctly position waterstops during installation. Support and anchor waterstops during progress of work to ensure proper embedment in concrete and to prevent folding over of waterstop by concrete placement. Locate symmetrical halves of waterstops equally between concrete pours at joints, with center axis coincident with joint openings. Thoroughly work concrete in joint vicinity for maximum density and imperviousness.
2. Where waterstop in a vertical wall joint does not connect with any other waterstop and is not intended to be connected to waterstop in future concrete placement, terminate waterstop 6 inches below top of wall.

C. Replacement of Defective Field Joints: Replace waterstop field joints showing evidence of misalignment, offset, porosity, cracks, bubbles, inadequate bond or other defects with products and joints complying with Specifications.

D. Resilient Waterstop:

1. Install resilient waterstop in accordance with manufacturer's instructions and recommendations.
2. When requested by Owner's Representative, provide technical assistance by manufacturer's representative in field at no additional cost to City.
3. Use resilient waterstop only where complete confinement by concrete is provided; do not use in expansion or contraction joints.
4. Where resilient waterstop is used in combination with PVC waterstop, lap resilient waterstop over PVC waterstop minimum of 6 inches and place in contact with PVC waterstop. Where crossing PVC at right angles, melt PVC ribs to form smooth joining surface.
5. At free top of walls without connecting slabs, stop resilient waterstop and grooves (where used) 6 inches from top in vertical wall joints.
6. Bentonite Waterstop:
 - a. Locate bentonite waterstop as near as possible to center of joint and extend continuous around entire joint. Minimum distance from edge of waterstop to face of member: 5 inches.
 - b. Where thickness of concrete member to be placed on bentonite waterstop is less than 12 inches, place waterstop in grooves at least 3/4 inch deep and 1 1/4 inches wide formed or ground into concrete. Minimum distance from edge of waterstop placed in groove to face of member: 2.5 inches.
 - c. Do not place bentonite waterstop when waterstop material temperature is below 40 degrees F. Waterstop material may be warmed so that it remains above 40 degrees F during placement but means used to warm it shall in no way harm material or its properties. Do not install waterstop where air temperature falls outside manufacturer's recommended range.
 - d. Place bentonite waterstop only on smooth and uniform surfaces; grind concrete smooth when necessary to produce satisfactory substrate, or bond waterstop to irregular surfaces using epoxy grout which completely fills voids and irregularities beneath waterstop material. Prior to installation, wire brush concrete surface to remove laitance and other substances that may interfere with bonding of epoxy.

- e. In addition to adhesive backing provided with waterstop, secure bentonite waterstop in place with concrete nails and washers at 12 inch maximum spacing.
- 7. Adhesive Waterstop:
 - a. With wire brush thoroughly clean concrete surface on which waterstop is to be placed and then coat with primer.
 - b. If surface is too rough to allow waterstop to form complete contact, grind to form adequately smooth surface.
 - c. Install waterstop with top protective paper left in place. Overlap joints between strips minimum of 1 inch and cover back over with protective paper.
 - d. Do not remove protective paper until just before final form work completion. Place concrete immediately. time that waterstop material is uncovered prior to concrete placement shall be minimized and shall not exceed 24 hours.

3.7 CONSTRUCTION JOINTS

A. Definitions:

- 1. Construction joint: Contact surface between plastic (fresh) concrete and concrete that has attained initial set.
- 2. Monolithic: Manner of concrete placement to reduce or eliminate construction joints; joints other than those indicated on Drawings will not be permitted without written approval of Owner's Representative. Where so approved, make additional construction joints with details equivalent to those indicated for joints in similar locations.
- 3. Preparation for Construction Joints: Roughen surface of concrete previously placed, leaving some aggregate particles exposed. Remove laitance and loose materials by sandblasting or high-pressure water blasting. Keep surface wet for several hours prior to placing of plastic concrete.

3.8 CURING

- A. Comply with ACI 308. Cure by preventing loss of moisture, rapid temperature change and mechanical injury for period of 7 curing days when Type II or IP cement has been used and for 3 curing days when Type III cement has been used. Start curing as soon as free water has disappeared from concrete surface after placing and finishing. A curing day is any calendar day in which temperature is above 50 degrees F for at least 19 hours. Colder days may be counted when air temperature adjacent to concrete is maintained above 50 degrees F. In continued cold weather, when artificial heat is not provided, removal of forms and shoring may be permitted at end of calendar days equal to twice required number of curing days. However, leave soffit forms and shores in place until concrete has reached specified 28 day strength, unless directed otherwise by Owner's Representative.
- B. Cure formed surfaces not requiring rubbed-finished surface by leaving forms in place for full curing period. Keep wood forms wet during curing period. Add water as needed for other types of forms. Or, at Contractor's option, forms may be removed after 2 days and curing compound applied.
- C. Rubbed Finish:
 - 1. At formed surfaces requiring rubbed finish, remove forms as soon as practicable without damaging surface.
 - 2. After rubbed-finish operations are complete, continue curing formed surfaces by using either approved curing/sealing compounds or moist cotton mats until normal curing period is complete.
- D. Unformed Surfaces: Cure by membrane curing compound method.

1. After concrete has received final finish and surplus water sheen has disappeared, immediately seal surface with uniform coating of approved curing compound, applied at rate of coverage recommended by manufacturer or as directed by Owner's Representative. Do not apply less than 1 gallon per 180 square feet of area. Provide satisfactory means to properly control and check rate of application of compound.
2. Thoroughly agitate compound during use and apply by means of approved mechanical power pressure sprayers equipped with atomizing nozzles. For application on small miscellaneous items, hand-powered spray equipment may be used. Prevent loss of compound between nozzle and concrete surface during spraying operations.
3. Do not apply compound to dry surface. When concrete surface has become dry, thoroughly moisten surface immediately prior to application. At locations where coating shows discontinuities, pinholes, or other defects, or when rain falls on newly coated surface before film has dried sufficiently to resist damage, apply additional coat of compound at specified rate of coverage.

3.9 REMOVAL OF FORMS AND SHORING

- A. Remove forms from surfaces requiring rubbing only as rapidly as rubbing operation progresses. Remove forms from vertical surfaces not requiring rubbed-finish when concrete has aged for required number of curing days. When curing compound is used, do not remove forms before 2 days after concrete placement.
- B. Leave soffit forms and shores in place until concrete has reached specified 28-day strength, unless directed otherwise by Owner's Representative.

3.10 DEFECTIVE WORK

- A. Immediately repair defective work discovered after forms have been removed. When concrete surface is bulged, uneven, or shows excess honeycombing or form marks which cannot be repaired satisfactorily through patching, remove, and replace entire section.

3.11 FINISHING

- A. Patch honeycomb, minor defects, and form tie holes in concrete surfaces with cement mortar mixed one part cement to two parts fine aggregate. Repair defects by cutting out unsatisfactory material and replacing with new concrete, securely keyed and bonded to existing concrete. Finish to make junctures between patches and existing concrete as inconspicuous as possible. Use stiff mixture and thoroughly tamp into place. After each patch has stiffened sufficiently to allow for greatest portion of shrinkage, strike off mortar flush with surface.
- B. Apply rubbed finish to exposed surfaces of formed concrete structures as noted on Drawings. After pointing has set sufficiently, wet surface with brush and perform first surface rubbing with No. 16 carborundum stone or approved equal. Rub sufficiently to bring surface to paste, to remove form marks and projections, and to produce smooth, dense surface. Add cement to form surface paste as necessary. Spread or brush material, which has been ground to paste, uniformly over surface and allow to reset. In preparation for final acceptance, clean surfaces and perform final finish rubbing with No. 30 carborundum stone or approved equal. After rubbing, allow paste on surface to reset; then wash surface with clean water. Leave structure with clean, neat, and uniform-appearing finish.
- C. Apply wood float finish to concrete slabs.

3.12 FIELD QUALITY CONTROL

- A. Testing shall be performed under provisions of Division 1.
- B. Unless otherwise directed by Owner's Representative, following minimum testing of concrete is required. Testing shall be performed by qualified individuals employed by approved independent testing agency and conform to requirements of ASTM C 1077.
 - 1. Take concrete samples in accordance with ASTM C 172.
 - 2. Make one set of four compression test specimens for each mix design at least once per day and for each 150 cubic yards or fraction thereof. Make, cure and test specimens in accordance with ASTM C 31 and ASTM C 39.
 - 3. When taking compression test specimens, test each sample for slump according to ASTM C 143, for temperature according to ASTM C 1064, for air content according to ASTM C 231, and for unit weight according to ASTM C 138.
 - 4. Inspect, sample and test concrete in accordance with ASTM C 94, Section 13, 14, and 15, and ACI 311-5R.
- C. Test Cores: Conform to ASTM C 42.
- D. Testing High Early Strength Concrete: When Type III cement is used in concrete, specified 7 day and 28 day compressive strengths shall be applicable at 3 and 7 days, respectively.
- E. If 7-day or 3-day test strengths (as applicable for type of cement being used) fail to meet established strength requirements, extended curing or resumed curing on those portions of structure represented by test specimens may be required. When additional curing fails to produce required strength, strengthening or replacement of portions of structure which fail to develop required strength may be required by Owner's Representative, at no additional cost to City.

3.13 PROTECTION

- A. Protect concrete against damage until final acceptance by City and/or County.
- B. Protect fresh concrete from damage due to rain, hail, sleet, or snow. Provide protection while concrete is still plastic, and whenever precipitation is imminent or occurring.
- C. Do not backfill around concrete structures or subject them to design loadings until components of structure needed to resist loading are complete and have reached specified 28 day compressive strength, except as authorized otherwise by Owner's Representative.

END OF SECTION

SECTION 33 06 10.14 - POLYVINYL CHLORIDE (PVC) PIPE

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Polyvinyl chloride pressure pipe for water distribution, in nominal diameters 4 inches through 20 inches.
- B. Polyvinyl chloride sewer pipe for gravity sewers in nominal diameters 4 inches through 48 inches.
- C. Polyvinyl chloride pressure pipe for gravity sewers and force mains in nominal diameters 4 inches through 20 inches.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices:
 - 1. No separate payment will be made for PVC pipe under this section. Include cost in unit price for work included as specified in the following sections:
 - a. Section 33 11 00 – Water Utility Distribution Piping
 - b. Section 33 31 00 – Sanitary Utility Sewerage Piping
 - c. Section 33 31 00.11 – Sanitary Sewage Force Mains
- B. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 REFERENCES

- A. 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 for Water Supply Service.
- B. ASTM D 1248 - Standard Specification for Polyethylene Plastics Molding and Extrusion Materials.
- C. ASTM D 1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
- D. ASTM D 2241 - Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).
- E. ASTM D 2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
- F. ASTM D 2444 - Standard Test Method for Determination of the Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight).
- G. ASTM D 2680 - Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly (Vinyl Chloride) (PVC) Composite Sewer Piping.
- H. ASTM D 3034 - Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
- I. ASTM D 3139 - Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.

- J. ASTM D 3212 - Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
- K. ASTM F 477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
- L. ASTM F 679 - Standard Specification for Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.
- M. ASTM F 794 - Standard Specification for Poly (Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter.
- N. ASTM F 949 - Standard Specification for Poly (Vinyl Chloride) (PVC) Corrugated Sewer Pipe with Smooth Interior and Fittings.
- O. AWWA C 110 - American National Standard for Ductile-Iron and Gray-Iron Fittings, 3 Inches Through 48 Inches for Water.
- P. AWWA C 111 - American National Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- Q. AWWA C 900 - Standard for Polyvinyl Chloride (PVC) Pressure Pipe, 4 Inches Through 12 Inches for Water Distribution.
- R. AWWA C 905 - Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 In. Through 48 In., for Water Transmission and Distribution.
- S. AWWA C 909 - Standard for Molecularly-Oriented Polyvinyl Chloride (PVCO) Pressure Pipe, 4 Inches through 12 Inches (100mm through 300 mm), for Water Distribution.
- T. PPI TR3 - Policies and Procedures for Developing Recommended Hydrostatic Design Stresses for Thermoplastic Pipe Materials.
- U. UNI-B-13 - Recommended Standard Performance Specification for Joint Restraint Devices for Use with Polyvinyl Chloride Pipe.

1.4 SUBMITTALS

- A. Conform to requirements of Division 1.
- B. Submit shop drawings showing design of new pipe and fittings indicating alignment and grade, laying dimensions, fabrication, fittings, flanges, and special details.

1.5 QUALITY CONTROL

- A. Submit manufacturer's certifications that PVC pipe and fittings meet requirements of this Section and AWWA C 900, AWWA C 909 and AWWA C 905 for pressure pipe applications, or appropriate ASTM standard specified for gravity sewer pipe.
- B. Submit manufacturer's certification that PVC pressure pipe for water lines and force mains has been hydrostatically tested at factory in accordance with AWWA C 900, AWWA C 909 and AWWA C 905, and this Section.
- C. When foreign manufactured material is proposed for use, have material tested for conformance to applicable ASTM requirements by certified independent testing laboratory

located in United States. Certification from other source is not acceptable. Furnish copies of test reports to Owner's Representative for review. Cost of testing paid by Contractor.

PART 2 PRODUCTS

2.1 MATERIAL

- A. Use PVC compounds in manufacture of pipe that contain no ingredient in amount that has been demonstrated to migrate into water in quantities considered to be toxic.
- B. Furnish PVC pressure pipe manufactured from Class 12454-A or Class 12454-B virgin PVC compounds as defined in ASTM D 1784. Use compounds qualifying for rating of 4000 psi for water at 73.4 F per requirements of PPI TR3. Provide pipe which is homogeneous throughout, free of voids, cracks, inclusions, and other defects, uniform as commercially practical in color, density, and other physical properties. Deliver pipe with surfaces free from nicks and scratches with joining surfaces of spigots and joints free from gouges and imperfections which could cause leakage.
- C. PVC Restrained Pipe: Must be listed on City's current Product Approval List.
 - 1. Pipe Material:
 - a. DR 18: For restrained joints where shown on Drawings.
 - b. DR 14: For alternate to offset pipe sections shown on Drawings. Do not use PVC for offset sections with depth of cover greater than 20 feet or less than 4 feet. Do not use PVC in potentially petroleum contaminated areas.
- D. Water Service.
 - 1. Provide self-extinguishing PVC pipe that bears Underwriters' Laboratories mark of approval and is acceptable without penalty to Texas State Fire Insurance Committee for use in fire protection lines.
 - 2. Bear National Sanitation Foundation Seal of Approval (NSF-PW).
- E. Gaskets:
 - 1. Gaskets shall meet requirements of ASTM F 477. Use elastomeric factory-installed gaskets to make joints flexible and watertight.
 - 2. Flat Face Mating Flange: Full faces 1/8-inch-thick ethylene propylene (EPR) rubber.
 - 3. Raised Face Mating Flange: Flat ring 1/8-inch ethylene propylene (EDR) rubber, with filler gasket between OD of raised face and flange OD to protect flange from bolting moment.
- F. Lubricant for rubber-gasketed joints: Water soluble, non-toxic, non-objectionable in taste and odor imparted to fluid, non-supporting of bacteria growth, having no deteriorating effect on PVC or rubber gaskets.
- G. Do not use PVC in potentially or known contaminated areas.
- H. Do not use PVC in areas exposed to direct sunlight.

2.2 WATER SERVICE PIPE

- A. Pipe 4 inch through 12 inch: AWWA C 900, AWWA C 909, Class 150, DR 18; AWWA C 900, Class 200, DR 14 as alternate to offset pipe sections; nominal 20-foot lengths; cast-iron equivalent outside diameters.

- B. Pipe 14 inch through 20 inch: AWWA C 905; Class 235; DR 18; nominal 20-foot lengths; cast-iron equivalent outside diameter.
- C. Provide Polyvinyl Chloride Pipe from approved manufacturers.
- D. Make curves and bends by deflecting joints. Do not exceed maximum deflection recommended by pipe manufacturer. Submit details of other methods of providing curves and bends for review by Owner's Representative.
- E. Hydrostatic Test: AWWA C 900, AWWA C 905, AWWA C 909, ANSI A 21.10 (AWWA C 110); at point of manufacture; submit manufacturer's written certification.

2.3 GRAVITY SEWER PIPE

- A. PVC gravity sanitary sewer pipe and storm sewer pipe shall be in accordance with provisions in following table:

| Wall Construction | Manufacturer | ASTM Designation | SDR (Max.)/ Stiffness (Min.) | Diameter Size Range |
|-------------------|-----------------|------------------|---------------------------------|---------------------------|
| Solid | J-M Pipe | D3034 | SDR 26 / PS 115 | 6" to 10" |
| | Certain Teed | D3034 | SDR 35 / PS 46 | 12" & 15" |
| | Diamond | F679 | SDR 35 / PS 46 | 18" to 27" |
| | Uponor ETI | AWWA C900 | DR 18 / N/A | 4" to 12" |
| | North American | AWWA C909 | DR 18 / N/A | 4" to 12" |
| | | AWWAC905 | DR 18 / N/A | 14" to 16" |
| Truss (Gasketed) | Contech | D2680 | N/A / 200 psi | 8" to 15" |
| Profile | Contech A-2000 | F949 | N/A / 46 psi | 12" to 36" |
| | Contech A-2026 | F949 | N/A / 115 psi | 8" to 10" |
| | ETI, Ultra-Rib | F794 | N/A / 46 psi | 8" to 30" |
| | ETI, Ultra-Corr | F794 | N/A / 46 psi | 24" to 36" |

- B. When solid wall PVC pipe 18 inches to 27 inches in diameter is required in SDR 26, provide pipe conforming to ASTM F 679, except provide wall thickness as required for SDR 26 and pipe strength of 115 psi.
- C. For sewers up to 12-inch diameter crossing over water lines or crossing under water lines with less than 2-feet separation, provide minimum 150 psi pressure-rated pipe conforming to ASTM D 2241 with suitable PVC adapter couplings.
- D. Joints: Spigot and integral wall section bell with solid cross section elastomeric or rubber ring gasket conforming to requirements of ASTM D 3212 and ASTM F 477, or ASTM D 3139 and ASTM F 477. Gaskets shall be factory-assembled and securely bonded in place to prevent displacement. Manufacturer shall test sample from each batch conforming to requirements ASTM D 2444.
- E. Fittings: Provide PVC gravity sewer sanitary bends, tee, or wye fittings for new sanitary sewer construction. PVC pipe fittings shall be full-bodied, either injection molded or factory fabricated. Saddle-type tee or wye fittings are not acceptable.
- F. Conditioning. Conditioning of samples prior to and during tests is subject to approval by Owner's Representative. When referee tests are required, condition specimens in accordance with Procedure A in ASTM D 618 at 73.4 degrees F plus or minus 3.6 degrees F and 50 percent relative humidity plus or minus 5 percent relative humidity for not less than

40 hours prior to test. Conduct tests under same conditions of temperature and humidity unless otherwise specified.

- G. Pipe Stiffness. Determine pipe stiffness at 5 percent deflection in accordance with Test Method D 2412. Minimum pipe stiffness shall be 46 psi. For diameters 4 inches through 18 inches, test three specimens, each a minimum of 6 inches (152 mm) in length. For diameters 21 inch through 36 inch, test three specimens, each a minimum of 12 inch (305 mm) in length.
- H. Flattening. Flatten three specimens of pipe, prepared in accordance with Paragraph 2.04F, in suitable press until internal diameter has been reduced to 60 percent of original inside diameter of pipe. Rate of loading shall be uniform. Test specimens, when examined under normal light and with unaided eye, shall show no evidence of splitting, cracking, breaking, or separation of pipe walls or bracing profiles. Perform the flattening test in conjunction with pipe stiffness test.
- I. Joint Tightness. Test for joint tightness in accordance with ASTM D 3212, except that joint shall remain watertight at minimum deflection of 5 percent. Manufacturer will be required to provide independent third-party certification for joint testing each diameter of storm sewer pipe.
- J. Purpose of Tests. Flattening and pipe stiffness tests are intended to be routine quality control tests. Joint tightness test is intended to qualify pipe to specified level of performance.

2.4 SANITARY SEWER FORCE MAIN PIPE

- A. Provide approved PVC pressure pipe conforming to requirements for water service pipe and conforming to minimum working pressure rating specified in Division 33.
- B. Acceptable pipe joints are integral bell-and-spigot, containing a bonded-in elastomeric sealing ring meeting requirements of ASTM F 477. In designated areas requiring restrained joint pipe and fittings, use approved joint restraint device conforming to UNI-B-13, for PVC pipe 12-inch diameter and less.
- C. Fittings: Provide approved ductile iron fittings as per Division 33, except furnish fittings with one of following approved internal linings:
 - 1. Nominal 40 mils (35 mils minimum) virgin polyethylene complying with ASTM D 1248, heat fused to interior surface of fitting
 - 2. Nominal 40 mils (35 mils minimum) polyurethane
 - 3. Nominal 40 mils (35 mils minimum) ceramic epoxy
 - 4. Nominal 40 mils (35 mils minimum) fusion bonded epoxy
- D. Exterior Protection: Provide polyethylene wrapping of ductile-iron fittings as required by Division 33.
- E. Hydrostatic Tests: Hydrostatically test pressure rated pipe in accordance with Paragraph 2.02E.

2.5 BENDS AND FITTINGS FOR PVC PRESSURE PIPE

- A. Bends and Fittings: ANSI A 21.10 or ANSI A 21.53, ductile iron; ANSI A 21.11 single rubber gasket push-on type joint; minimum 150 psi pressure rating. Approved restrained joints, 250 200 psi, may be provided for up to 12 inches in diameter (water or sanitary).

- B. Provide approved restrained joint fittings: Integral restrained joint fittings and pipe do not require secondary restraint.

PART 3 EXECUTION

3.1 PROTECTION

- A. Store pipe under cover out of direct sunlight and protect from excessive heat or harmful chemicals in accordance with manufacturer's recommendations.

3.2 INSTALLATION

- A. Conform to requirements of Division 33, as applicable.
- B. Install PVC pipe in accordance with Division 33, ASTM D 2321 for Sewer Pipe, and manufacturer's recommendations.
- C. Install PVC water service pipe to clear utility lines and have minimum depth of cover below property line grade of street, unless otherwise required by Drawings:
 - 1. Water service pipe 12 inches in diameter and smaller 4 feet of cover.
 - 2. Water service pipe 16 inches in diameter and larger 5 feet of cover.
- D. Avoid imposing strains that will overstress or buckle pipe when lowering pipe into trench.
- E. Hand shovel pipe bedding under pipe haunches and along sides of pipe barrel and compact to eliminate voids and ensure side support.
- F. Store PVC pipe under cover out of direct sunlight. Protect pipe from excessive heat or harmful chemicals. Prevent damage by crushing or piercing.
- G. Allow PVC pipe to cool to ground temperature before backfilling when assembled out of trench to prevent pullout due to thermal contraction.

3.3 PVC RESTRAINED MECHANISM

- A. Do not apply lubricant to spline or pipe or coupling spline grooves.
- B. Do not use excessive force while inserting the spline through coupling.
- C. Insert spline until it is fully seated around circumference of pipe.
- D. Field Cutting of Pipe Ends:
 - 1. Perform by workers certified by manufacturer.
 - 2. Use a PVC pipe cutter and provide square ends.
 - 3. Use manufacturer approved power routing and grooving tool to field fabricate required pipe groove.

END OF SECTION

SECTION 33 06 40.10 - HDPE SOLID AND PROFILE WALL PIPE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. High density polyethylene (HDPE) pipe for gravity sewers and drains, including fittings.
- B. High density polyethylene (HDPE) pipe for sanitary sewer force mains, including fittings.
- C. High density polyethylene (HDPE) pipe for storm sewers culverts.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices.
 - 1. No separate payment will be made for HDPE pipe under this Section. Include cost in unit prices for work, as specified in Division 33.
 - 2. Refer to Division 1 for unit price procedures.
- B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 REFERENCES

- A. AASHTO M 294 - Standard Specification for Corrugated Polyethylene Drainage Pipe, 18"-48" diameter.
- B. AASHTO Section 18 - Soil Thermoplastic Pipe Interaction Systems.
- C. AASHTO Section 30 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewer and Other Gravity Flow Applications.
- D. ASTM D 618 - Standard Practice for Conditioning Plastics for Testing.
- E. ASTM D 1248 - Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable.
- F. ASTM D 2321 - Standard Recommended Practice for Underground Installation of Flexible Thermoplastic Pipe.
- G. ASTM D 2657 - Standard Practice for Heat Fusion Joining Polyolefin Pipe and Fittings.
- H. ASTM D 2837 - Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials.
- I. ASTM D 3035 - Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter.
- J. ASTM D 3212 - Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
- K. ASTM D 3350 - Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.
- L. ASTM F 477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

- M. ASTM F 714 - Standard Specification for Polyethylene Plastic (PE) Pipe (SDR-PR) Based on Outside Diameter.
- N. ASTM F 894 - Standard Specification for Polyethylene (PE) Large-Diameter Profile Wall Sewer and Drain Pipe.

1.4 SUBMITTALS

- A. Conform to requirements of Division 1.
- B. Submit shop drawings showing design of pipe and fittings, laying dimensions, fabrication, fittings, flanges, and special details.

1.5 QUALITY CONTROL

- A. Provide manufacturer's certificate of conformance to Specifications.
- B. Furnish pipe and fittings that are homogeneous throughout and free from visible cracks, holes, foreign inclusions, or other injurious defects. Provide pipe as uniform as commercially practical in color, opacity, density, and other physical properties.
- C. Owner's Representative reserves right to inspect pipes or witness pipe manufacturing. Inspection shall in no way relieve manufacturer of responsibilities to provide products that comply with applicable standards and these Specifications.
 - 1. Manufacturer's Notification: Should Owner's Representative wish to witness manufacture of specific pipes; manufacturer shall provide Owner's Representative with minimum three weeks notice of when and where production of those specific pipes will take place.
 - 2. Failure to Inspect. Approval of products or tests is not implied by Owner's Representative's decision not to inspect manufacturing, testing, or finished pipes.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the products specified in this section with documented experience of minimum 5 years of pipe installations that have been in successful, continuous service for same type of service as proposed Work.

PART 2 PRODUCTS

2.1 GENERAL

- A. For sanitary sewer pipe provide HDPE pipe as follows:
 - 1. NEW CONSTRUCTION PIPE PRODUCTS GRAVITY SANITARY SEWER DIRECT BURY

| INSTALLATION SPEC NO. | GENERIC NAME | TRADE NAME OR MANUFACTURER | ASTM or AASHTO | SDR (NUMERIC MAXIMUM) | PIPE STIFFNESS (NUMERIC MINIMUM) | SIZE RANGE |
|-----------------------|--------------------------------|---|----------------|-----------------------|----------------------------------|-----------------------|
| 02505 | Solid Wall Polyethylene (HDPE) | Chevron Plexco Phillip 66 Quail Poly Pipe | ASTM F-714 | DR 17 DR 21 | 115 46 | 8" – 10" 12" – 48" |
| | Polyethylene | Spirolity | ASTM | n/a | 46 | 18"–120" |

| | | | | | | |
|-------|--------------|--|-------|--|--|--|
| 02531 | Profile Wall | | F-894 | | | |
|-------|--------------|--|-------|--|--|--|

2. REHABILITATION CONSTRUCTION PIPE PRODUCTS SLIPLINING OF SANITARY SEWER

| INSTALLATION SPEC NO. | GENERIC NAME | TRADE NAME OR MANUFACTURER | ASTM | SDR (NUMERIC MAXIMUM) | PIPE STIFFNESS (NUMERIC MINIMUM) | SIZE RANGE |
|-----------------------|---------------------------|---|-------|-----------------------|----------------------------------|-----------------------------------|
| 02550 | Solid Wall Poly | Chevron Plexco Quail Poly Pipe AmeriFlow by NAPCO Ameriflow by KWH | F-714 | DR 21 | 46 | 8" – 48" 3" – 12" 14" – 63" |
| 02550 | Polyethylene Profile Wall | Spirolity | F-894 | n/a | 46 | 18"–120" |

- B. For Storm Sewer and Residential Driveway Culverts provide HDPE as follows:
1. N-12 and N-12 HC by Advanced Drainage Systems, Inc. (ADS).
 2. Sure-Lok F477 by Hancor, Inc.
- C. Furnish solid wall pipe with plain end construction for heat joining (butt fusion) conforming to ASTM D 2657. Utilize controlled temperatures and pressures for joining to produce fused leak-free joint.
- D. Furnish profile-wall gravity sewer pipe with bell-and-spigot end construction conforming to ASTM D 3212. Joining will be accomplished with elastomeric gasket in accordance with manufacturer's recommendations. Use integral bell-and-spigot gasketed joint designed so that when assembled, elastomeric gasket, contained in machined groove on pipe spigot, is compressed radially in pipe bell to form positive seal. Design joint to avoid displacement of gasket when installed in accordance with manufacturer's recommendations.
- E. Furnish solid wall pipe for sanitary sewer force mains with minimum working pressure rating of 150 psi, and with inside diameter equal to or greater than nominal pipe size indicated on Drawings.
- F. Furnish corrugated polyethylene pipe (CPP) for gravity storm sewer pipe. Joints shall be installed such that connection of pipe sections will form continuous line free from irregularities in flow line. Suitable joints are:
1. Integral Bell and Spigot. Bell shall overlap minimum of two corrugations of spigot end when fully engaged conforming to the requirements of ASTM F-477.
- G. Jointing:
1. Gaskets:
 - a. Meet requirements of ASTM F 477. Use gasket molded into circular form or extruded to proper section and then spliced into circular form. When no contaminant is identified, use gaskets of properly cured, high-grade elastomeric compound. Basic polymer shall be natural rubber, synthetic elastomer, or blend of both.

- b. Pipes allowed to be installed in potentially contaminated areas, where free product is found near elevation of proposed sewer, shall have the following gasket materials for noted contaminants:

| Contaminant | Gasket Material Required |
|------------------------------|-------------------------------------|
| Petroleum (diesel, gasoline) | Nitrile Rubber |
| Other contaminants | As recommended by pipe manufacturer |

- 2. Lubricant. Use lubricant for assembly of gasketed joints which has no detrimental effect on gasket or on pipe, in accordance with manufacturer's recommendations.

2.2 MATERIALS FOR SANITARY SEWER

- A. Pipe and Fittings: High density, high molecular weight polyethylene pipe material meeting requirements of Type III, Class C, Category 5, Grade P34, as defined in ASTM D 1248. Material meeting requirements of cell classification in accordance with ASTM D 3350 are also suitable for making pipe products under these specifications.
- B. Other Pipe Materials: Materials other than those specified in Paragraph 2.02A, Pipe and Fittings, may be used as part of profile construction, e.g., as core tube to support shape of profile during processing, provided that these materials are compatible with base polyethylene material and are completely encapsulated in finished product and in no way compromise performance of pipe products in intended use. Examples of suitable material include polyethylene and polypropylene.

2.3 MATERIALS FOR STORM SEWERS AND RESIDENTIAL DRIVEWAY CULVERTS

- A. Pipe and Fittings: High density, high molecular weight polyethylene HDPE virgin compound material meeting requirements of cell class outlined in AASHTO M 294, AASHTO MP7 and ASTM D 3350.
- B. Types: CPP shall meet one or both of following:
 - 1. Type S: Outer corrugated wall with smooth inner liner.
 - 2. Type D: Inner and outer smooth walls braced circumferentially or spirally with projections or ribs.
- C. Lubricant: Use lubricant for assembly of gasketed joints, which has no detrimental effect on gasket or on pipe, in accordance with manufacturer's recommendations.

2.4 TEST METHODS FOR SANITARY SEWER

- A. Conditioning. Conditioning of samples prior to and during tests is subject to approval by Owner's Representative. When referee tests are required, condition specimens in accordance with Procedure A in ASTM D 618 at 73.4 degrees F plus or minus 3.6 degrees F and 50 percent relative humidity plus or minus 5 percent relative humidity for not less than 40 hours prior to test. Conduct tests under same conditions of temperature and humidity unless otherwise specified.
- B. Flattening. Flatten three specimens of pipe, prepared in accordance with Paragraph 2.05A, in suitable press until internal diameter has been reduced to 40 percent of original inside diameter of pipe. Rate of loading shall be uniform and at 2 inches per minute. Test specimens, when examined under normal light and with unaided eye, shall show no evidence of splitting, cracking, breaking, or separation of pipe walls or bracing profiles.

- C. Joint Tightness. Test for joint tightness in accordance with ASTM D 3212, except replace shear load transfer bars and supports with 6-inch-wide support blocks that can be either flat or contoured to conform to pipe's outer contour.
- D. Purpose of Tests. Flattening and joint tightness tests are not intended to be routine quality control tests, but rather to qualify pipe to a specified level of performance.

2.5 TEST METHODS FOR STORM SEWERS AND RESIDENTIAL DRIVEWAY CULVERTS

- A. Pipe stiffness at 5 percent deflection, when determined in accordance with ASTM D 2412, shall be as specified in Section 7.4 of AASHTO M 294.
- B. Minimum inner wall thickness shall be as specified in Section 7.2.2 of AASHTO M 294.

2.6 MARKING

- A. Mark each standard and random length of pipe in compliance with these Specifications with following information:
 - 1. Pipe size.
 - 2. Pipe class.
 - 3. Production code.
 - 4. Material designation.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Conform to requirements of Division 33.
- B. Install pipe in accordance with the manufacturers recommended installation procedures.
- C. HDPE pipe is not approved in applications requiring auguring of pipe.
- D. Bedding and backfill: Conform to requirements of Division 31.

END OF SECTION

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SECTION 33 06 40.11 - REINFORCED CONCRETE PIPE

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Reinforced concrete pipe for storm sewers.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices:
 - 1. No separate payment will be made for HDPE pipe under this Section. Include cost in unit prices for work, as specified in the following sections:
 - a. Section 33 41 00 - Storm Utility Drainage Piping.
- B. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for work in this Section is included in the total Stipulated Price.

1.3 REFERENCES

- A. ASTM C 76 - Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
- B. ASTM C 443 - Joints for Circular Concrete Sewer and Culvert Pipe.
- C. ASTM C 497 - Method of Testing Concrete Pipe, Sections, or Tile.
- D. ASTM C 506 - Reinforced Concrete Arch Culvert, Storm Drain and Sewer Pipe.
- E. ASTM C 507 - Reinforced Concrete Elliptical Culvert, Storm Drain and Sewer Pipe.
- F. ASTM C 655 - Reinforced Concrete D-load Culvert, Storm Drain and Sewer Pipe.
- G. ASTM C 822 - Standard Definitions and Terms Relating to Concrete Pipe and Related Products.
- H. ASTM C 877 - Standard Specification for External Sealing Bands for Non circular Concrete Sewer, Storm Drain, and Culvert Pipe.

1.4 SUBMITTALS

- A. Submittals shall conform to requirements in Division 1.
- B. Submit complete product data for pipe, fittings and gaskets for approval. Indicate conformance to appropriate reference standards.
- C. Submit certificates by a testing laboratory, hired and paid by the manufacturer, that concrete pipes meet applicable standards when tested in accordance with ASTM C 497.

PART 2 PRODUCTS

2.1 REINFORCED CONCRETE PIPE

- A. Circular reinforced concrete pipe shall conform to requirements of ASTM C 76, for Class III wall thickness. Joints shall be rubber gasketed conforming to ASTM C 443.
- B. Reinforced concrete arch pipe shall conform to the requirements of ASTM C 506 for Class A-III. Joints shall conform to ASTM C 877.
- C. Reinforced concrete elliptical pipe, either vertical or horizontal, shall conform to the requirements of ASTM C 507 for Class VE-III for vertical or Class HE-III for horizontal. Joints shall be rubber gaskets conforming to ASTM C 877.
- D. Reinforced concrete D-load pipe shall conform to the requirements of ASTM C 655.

2.2 GASKETS

- A. When no contaminant is identified, furnish rubber gasket conforming to ASTM C 443 for circular reinforced concrete pipe and rubber gasket conforming to ASTM C 877 for reinforced concrete elliptical pipe.
- B. Pipes to be installed in potentially contaminated areas, especially where free product is found near the elevation of the proposed sewer, shall have the following gasket materials for the noted contaminants:

| CONTAMINANT | GASKET MATERIAL REQUIRED |
|------------------------------|---|
| Petroleum (diesel, gasoline) | Nitrile Rubber |
| Other Contaminants | As recommended by the pipe manufacturer |

2.3 SOURCE QUALITY CONTROL

- A. Representatives of Engineer will inspect manufacturer's plant and casting operations as deemed necessary.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Conform to requirements of the following Sections, as applicable:
 - 1. 33 41 00 - Storm Utility Drainage Piping
- B. Install reinforced concrete pipe in accordance with manufacturer's recommendations.

END OF SECTION

SECTION 33 11 00 - WATER UTILITY DISTRIBUTION PIPING

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Installation of water lines.
- B. Specifications identify requirements for both small diameter water lines and large diameter water lines. When specifications for large diameter water lines differ from those for small diameter water lines, large diameter specifications will govern for large diameter pipe.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices:
 - 1. Payment for water utility distribution piping will be by type and size on a linear foot basis.
- B. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 REFERENCES

- A. ANSI A 21.11/AWWA C111 - Standard for Rubber-Gasket Joints for Ductile - Iron Pressure Pipe and Fittings
- B. ANSI/NSF Standard 61 - Drinking Water System -Health Components
- C. ASTM A 36 - Standard Specification for Carbon Structural Steel
- D. ASTM A 536 - Standard Specification for Ductile Iron Castings
- E. ASTM A 126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
- F. ASTM B 21 - Standard Specification for Naval Brass Rod, Bar, and Shapes
- G. ASTM B 98 - Standard Specification for Copper-Silicon Alloy Rod, Bar, and Shapes
- H. ASTM B 301 - Standard Specification for Free-Cutting Copper Rod and Bar
- I. ASTM B 584 - Standard Specification for Copper Alloy Sand Casting for General Application.
- J. ASTM E 165 - Standard Test Method for Liquid Penetrant Examination
- K. ASTM E 709 - Standard Guide for Magnetic Particle Examination
- L. ASTM F 1674 - Standard Test Method for Joint Restraint Products for Use with PVC Pipe
- M. AWWA C 206 - Standard for Field Welding of Steel Water Pipe
- N. AWWA C 207 - Standard for Steel Pipe Flanges for Waterworks Service - Sizes 4 Inches through 144 Inches

1.4 SUBMITTALS

- A. Conform to requirements of Division 1.
- B. Conform to submittal requirements of applicable Section for type of pipe used.
- C. Photographs: Submit photographs conforming to requirements of Division 1 prior to commencement of construction.
- D. Submit videotapes conforming to requirements of Division 1, if applicable.
- E. Submit Lone Star notification transmittal number prior to beginning excavation.
- F. Submit, a minimum of 15 days before beginning pipe laying operations, layout drawing identifying proposed sections for disinfecting, hydrostatic testing and site restoration for entire project for review and approval. Layout drawing to identify sequence of sections for:
 - 1. Disinfection; not to exceed 4,000 linear feet per section.
 - 2. Hydrostatic testing and transfer of services; to immediately follow sequence of disinfected section.
 - 3. Site restoration: not to exceed limits specified; Sequence in order of disturbance.

PART 2 PRODUCTS

2.1 PIPE MATERIALS

- A. Install pipe materials which conform to Division 33.
- B. Conform to American National Standards Institute/National Sanitation Foundation (ANSI/NSF) Standard 61 and have certified by an organization accredited by ANSI.
- C. Type of pipe materials used is Contractor's option unless specifically identified on Drawings.
- D. Provide minimum of 3/8 inch inside joint recess between ends of pipe in straight pipe sections.

2.2 WELDED JOINT PROTECTION FITTING FOR SMALL DIAMETER STEEL PIPE

- A. Cylindrical Corrosion Barrier: Provide approved cylindrical corrosion barrier.
- B. O-rings: Conform to National Sanitary Foundation requirements.

2.3 RESTRAINED JOINTS

- A. Ductile-Iron Pipe: See Division 33.
- B. PVC Pipe: See Division 33. Perform hydrostatic testing in accordance with ASTM F 1674.
- C. Prestressed Concrete Cylinder Pipe, Bar-Wrapped Pipe and Steel Pipe: Welded joints (see Paragraph 3.06 D).
- D. Restrained Joints where required on DIP and PVC pipe:

1. Restraint devices: Manufacture of high strength ductile iron, ASTM A 536 up to 24 inches, and ASTM A 36 for sizes greater than 30 inches. Working pressure rating twice that of design test pressure.
2. Bolts and connecting hardware: High strength low alloy material in accordance with ANSI A21.11/AWWA C111.

2.4 COUPLINGS AND APPURTENANCES FOR LARGE DIAMETER WATERLINE

A. Flexible (Dresser-type) Couplings.

1. Install where shown on Drawings or where allowed by Owner's Representative for Contractor's convenience. Use galvanized flexible couplings when installed on galvanized pipe which is cement lined, or when underground. Provide gaskets manufactured from Neoprene or Buna-N.
2. For steel pipe; provide approved sleeve-type flexible couplings. Thickness of middle ring equal to or greater than thickness of pipe wall.
3. Provide approved flanged adapter couplings for steel pipe.
4. Use Type 316 stainless steel bolts, nuts and washers where flexible couplings are installed underground. Coat entire coupling with 20-mil of approved coal tar coating.

B. Flap Valves: Provide approved flap valves on discharge of manhole drainline as shown on Drawings.

1. Body and Flap: ASTM A 126-B cast iron.
2. Seats: ASTM B 21-CA482 or ASTM B 301-CA145 bronze.
3. Resilient Seat
4. Hinge Arms: ASTM B 584-CA865 high tensile bronze.
5. Hinge pins: ASTM B 98-CA655 silicon bronze.

PART 3 EXECUTION

3.1 PREPARATION

- A. Conform to applicable installation specifications for types of pipe used.
- B. Employ workmen who are skilled and experienced in laying pipe of type and joint configuration being furnished. Provide watertight pipe and pipe joints.
- C. Lay pipe to lines and grades shown on Drawings.
- D. Confirm that nine feet minimum separation from gravity sanitary sewers and manholes or separation of four feet minimum from force mains as specified in this Section in all directions unless special design is provided on Drawings.
- E. Where above clearances cannot be attained, and special design has not been provided on Drawings, obtain direction from Owner's Representative before proceeding with construction.
- F. Inform Owner's Representative if unmetered sprinkler or fire line connections exist which are not shown on Drawings. Make transfer only after approval by Owner's Representative.
- G. For projects involving multiple subdivisions or locations, limit water line installation to maximum of two project site locations. Maximizing 2 pipe installation crews shall be permitted, unless otherwise approved by Owner's Representative.

- H. Only the appropriate governing agency will handle operations involving opening and closing valves for wet connections and for chlorination. Contractor is responsible for handling necessary installations and removal of chlorination and testing taps and risers.
- I. If asbestos-cement (A.C.) pipe is encountered, follow safety practices outlined in American Water Works Association's publication, "Work Practices for A/C Pipe". Strictly adhere to "recommended practices" contained in this publication and make them "mandatory practices" for this Project.
- J. For pipe diameters 36 inches and greater, clearly mark each section of pipe and fitting with unique designation on inside of pipe along with pressure class. Locate unique identifying mark minimum of five feet away from either end of each section of pipe. Provide one unique identifying mark in middle of each fitting. Place markings at consistent locations. Use permanent black paint and minimum letter height of 4 inches to mark designations.
- K. Contractor is responsible for assuring chosen manufacturer fulfills requirements for extra fittings and, therefore, is responsible for costs due to downtime if requirements are not met.
- L. Do not remove plugs or clamps during months of peak water demands; June, July and August, unless otherwise approved by Owner's Representative.

3.2 HANDLING, CLEANING AND INSPECTION

- A. Handling:
 - 1. Place pipe along project site where storm water or other water will not enter or pass through pipe.
 - 2. Load, transport, unload, and otherwise handle pipe and fittings to prevent damage of any kind. Handle and transport pipe with equipment designed, constructed, and arranged to prevent damage to pipe, lining and coating. Do not permit bare chains, hooks, metal bars, or narrow skids or cradles to come in contact with coatings. Where required, provide pipe fittings with sufficient interior strutting or cross bracing to prevent deflection under their own weight.
 - 3. Hoist pipe from trench side into trench by means of sling of smooth steel cable, canvas, leather, nylon or similar material.
 - 4. For large diameter water lines, handle pipe only by means of sling of canvas, leather, nylon, or similar material. Sling shall be minimum 36 inches in width. Do not tear or wrinkle tape layers.
 - 5. Use precautions to prevent injury to pipe, protective linings, and coatings.
 - a. Package stacked pipe on timbers. Place protective pads under banding straps at time of packaging.
 - b. Pad fork trucks with carpet or other suitable material. Use nylon straps around pipe for lift when relocating pipe with crane or backhoe.
 - c. Do not lift pipe using hooks at each end of pipe.
 - d. Do not place debris, tools, clothing, or other materials on pipe.
 - 6. Repair damage to pipe or protective lining and coating before final acceptance.
 - 7. For cement mortar line and coated steel pipe and PCCP, permit no visible cracks longer than 6 inches, measured within 15 degrees of line parallel to pipe longitudinal axis of finished pipe, except:
 - a. In surface laitance of centrifugally cast concrete.
 - b. In sections of pipe with steel reinforcing collars or wrappers.
 - c. Within 12 inches of pipe ends.
 - 8. Reject pipe with visible cracks (not meeting exceptions) and remove from project site.

- B. Cleaning: Thoroughly clean and dry interior of pipe and fittings of foreign matter before installation and keep interior clean until Work has been accepted. Keep joint contact surfaces clean until jointing is completed. Do not place debris, tools, clothing, or other materials in pipe. After pipe laying and joining operations are completed, clean inside of pipe and remove debris.
- C. Inspection: Before installation, inspect each pipe and fitting for defects. Reject defective, damaged or unsound pipe and fittings and remove them from site.

3.3 EARTHWORK

- A. Conform to applicable provisions of Division 31.
- B. Bedding: Use bedding materials in conformance with Division 31.
- C. Backfill: Use bank run sand or earth, or native soil as specified in Division 31. Backfill excavated areas in same day excavated. When not possible, cover excavated areas using steel plates on paved areas and other protective measures elsewhere.
- D. Place material in uniform layers of prescribed maximum loose thickness and wet or dry material to approximately optimum moisture content. Compact to prescribed density Water tamping is not allowed.
- E. Pipe Embedment: Including 6-inch pipe bedding and backfill to 12 inches above top of pipe.

3.4 PIPE CUTTING

- A. Cut pipe 12 inches and smaller with standard wheel pipe cutters. Cut pipe larger than 12 inches in manner approved by Owner's Representative. Make cuts smooth and at right angles to axis of pipe. Bevel plain end with heavy file or grinder to remove sharp edges.

3.5 PIPING INSTALLATION

- A. General Requirements:
 - 1. Lay pipe in subgrade free of water.
 - 2. Make adjustments of pipe to line and grade by scraping away subgrade or filling in with granular material.
 - 3. Properly form bedding to fully support bell without wedging or blocking up bell.
 - 4. Open Cut Construction: Keep pipe trenches free of water which might impair pipe laying operations. Grade pipe to provide uniform support along bottom of pipe. Excavate for bell holes after bottom has been graded and in advance of placing pipe. Lay not more than nominal city block length of not more than 300 feet of pipe in trench ahead of backfilling operations. Cover or backfill laid pipe if pipe laying operations are interrupted and during non-working hours. Place backfill carefully and simultaneously on each side of pipe to avoid lateral displacement of pipe and damage to joints. If adjustment of pipe is required after it has been laid, remove, and re-lay as new pipe.
- B. Install pipe continuously and uninterrupted along each street on which work is to be performed. Obtain approval of Owner's Representative prior to skipping any portion of Work.
- C. Protection of Pipeline: Securely place stoppers or bulkheads in openings and in end of line when construction is stopped temporarily and at end of each day's work.

- D. Perform Critical Location as shown on Drawings. Refer to Division 33 for additional requirements at critical locations.

- E. Laying Large Diameter Water Line
 - 1. Lay not more than 50 feet of pipe in trench ahead of backfilling operations.
 - 2. Dig trench proper width as shown. When trench width below top of pipe becomes 4 feet wider than specified, install higher class of pipe or improved bedding, as determined by Owner's Representative. No additional payment will be made for higher class of pipe or improved bedding.
 - 3. Use adequate surveying methods and equipment; employ personnel competent in use of this equipment. Horizontal and vertical deviations from alignment as indicated on Drawings shall not exceed 0.10 feet. Measure and record "as-built" horizontal alignment and vertical grade at maximum of every 100 feet on record drawings.
 - 4. Prevent damage to coating when placing backfill. Use backfill material free of large rocks or stones, or other material which could damage coatings.
 - 5. Before assembling couplings, lightly coat pipe ends and outside of gaskets with cup grease or liquid vegetable soap to facilitate installation.
 - 6. Prior to proceeding with critical tie-ins submit sequence of work based on findings from "critical location" effort.

- F. Perform following additional procedures when working on plant sites.
 - 1. Seventy-two hours prior to each plant shut down or connection, schedule coordination meeting with Owner's Representative and Water Production personnel. At this meeting, present proposed sequencing of Work and verification of readiness to complete Work as required and within time permitted. Do not proceed with Work until Owner's Representative agrees key personnel, equipment and materials are on hand to complete Work.
 - 2. Prior to fully excavating around existing piping, excavate as minimal as possible to confirm type and condition of existing joints. Verify size, type, and condition of pipe prior to ordering materials or fully mobilizing for Work.
 - 3. Do not proceed with connections to existing piping and identified critical stages of work unless approved by Owner's Representative and the governing agency is present to observe.
 - 4. Coordinate with the governing agency to obtain reduction in operating pressures prior to performing connections to existing piping.
 - 5. Make connections to existing piping only when two valves are closed off between connection and source of water pressure. Do not make connection relying solely on one valve, unless otherwise approved by Owner's Representative.
 - 6. Perform critical stages of Work identified on Drawings at night or during low water demand months as specified in Division 1.
 - 7. Excavation equipment used on plant sites to have smooth bucket; no teeth or side cutters.
 - 8. Submit to Owner's Representative Lone Star Notification transmittal number prior to beginning excavation.
 - 9. Before each "dig" with mechanical excavator, probe ground to determine potential obstructions. Repeat procedure until existing pipe is located or excavation reaches desired elevation. Perform excavations within one foot to existing piping by hand methods.
 - 10. Provide adequate notice to pipe manufacturer's representative when connecting or modifying existing prestressed or pretension concrete cylinder pipe.
 - 11. Provide field surveyed (horizontal and vertical elevations) "as-builts" of new construction and existing underground utilities encountered. Submit in accordance with Division 1.

12. Prior to performing plant work to be done on weekend, provide list of sites and contact person with phone numbers to Owner's Representative by noon on Thursday of week. Contact person must be accessible during weekend, have Houston Metro Area phone number, and be authorized to make emergency decisions.
 13. No night work or plant shut down will be scheduled to begin two working days before or after designated Holidays.
- G. For tie-ins to existing water lines, provide necessary material on hand to facilitate connection prior to shutting down existing water line. Provide governing agency a minimum of two weeks notice prior to shutting down existing water line.

3.6 JOINTS AND JOINTING

- A. Rubber Gasketed Bell-and-Spigot Joints for Concrete Cylinder Pipe, Bar Wrapped Pipe PVC, Steel, and DIP:
1. After rubber gasket is placed in spigot groove of pipe, equalize rubber gasket cross section by inserting tool or bar recommended by manufacturer under rubber gasket and moving it around periphery of pipe spigot.
 2. Lubricate gaskets with nontoxic water-soluble lubricant before pipe units are joined.
 3. Fit pipe units together in manner to avoid twisting or otherwise displacing or damaging rubber gasket.
 4. After pipe sections are joined, check gaskets to ensure that no displacement of gasket has occurred. If displacement has occurred, remove pipe section and remake joint as for new pipe. Remove old gasket, inspect for damage and replace if necessary, before remaking joint.
 5. Where preventing movement of 16-inch diameter or greater pipe is necessary due to thrust, use restrained joints as shown on Drawings.
 - a. Include buoyancy conditions for soil unit weight when computing thrust restraint calculations.
 - b. Do not include passive resistance of soil in thrust restraint calculations.
 6. Except for PVC pipe, provide means to prevent full engagement of spigot into bell as shown on Drawings. Means may consist of wedges or other types of stops as approved by Owner's Representative.
- B. Flanged Joints where required on Concrete Cylinder Pipe, Bar Wrapped Pipe, Ductile Iron Pipe, or Steel Pipe:
1. AWWA C 207. Prior to installation of bolts, accurately center and align flanged joints to prevent mechanical prestressing of flanges, pipe and equipment. Align bolt holes to straddle vertical, horizontal, or north-south center line. Do not exceed 3/64 inch per foot inclination of flange face from true alignment.
 2. Use full-face gaskets for flanged joints. Provide 1/8-inch-thick cloth inserted rubber gasket material. Cut gaskets at factory to proper dimensions.
 3. Use galvanized or black nuts and bolts to match flange material. Use cadmium-plated steel nuts and bolts underground. Tighten bolts progressively to prevent unbalanced stress. Maintain at all times approximately same distance between two flanges at points around flanges. Tighten bolts alternately (180° apart) until all are evenly tight. Draw bolts tight to ensure proper seating of gaskets. Provide Densco petroleum-based tape or approved equal for all exposed portions of nuts, bolts and pipe.
 4. Full length bolt isolating sleeves and washers shall be used with flanged connections. Furnish kits in accordance with City of Houston's "Approved Products List."

5. For in-line flange joints 30 inches in diameter and greater and at butterfly valve flanges, provide Pyrox G-10 with nitrite seal, conforming to ANSI A 21.11 mechanical joint gaskets. For in-line flange joints sized between 12 inches in diameter and greater and 24 inches in diameter and smaller, provide Phenolic PSI with nitrite seal gasket conforming to ANSI A 21.11 mechanical joint gaskets.
- C. Welded Joints (Concrete Cylinder Pipe, Bar Wrapped Pipe, Steel Pipe):
1. Prior to starting work, provide certification of qualification for welders employed on project for type of work procedures and positions involved.
 2. Joints: AWWA C 206. Full-fillet, single lap-welded slip-type either inside or outside, or double butt-welded type; use automatic or hand welders; completely penetrate deposited metal with base metal; use filler metal compatible with base metal; keep inside of fittings and joints free from globules of weld metal which would restrict flow or become loose. Do not use mitered joints. For interior welded joints, complete backfilling before welding. For exterior field-welded joints, provide adequate working room under and beside pipe. Use exterior welds for 30-inch and smaller.
 3. Furnish welded joints with trimmed spigots and interior welds for 36-inch and larger pipe.
 4. Bell-and-spigot, lap-welded slip joints: Deflection may be taken at joint by pulling joint up to 3/4 inch as long as 1 ½ inch minimum lap is maintained. Spigot end may be miter cut to take deflections up to 5 degrees as long as joint tolerances are maintained. Miter end cuts of both ends of butt-welded joints may be used for joint deflections of up to 5 degrees.
 5. Align piping and equipment so that no part is offset more than 1/8 inch. Set fittings and joints square and true and preserve alignment during welding operation. For butt welded joints, align abutting ends to minimize offset between surfaces. For pipe of same nominal wall thickness, do not exceed 1/16 inch offset. Use line-up clamps for this purpose; however, take care to avoid damage to linings and coatings.
 6. Protect coal-tar-epoxy lining during welding by draping an 18-inch-wide strip of heat resistant material over top half of pipe on each side of lining holdback to avoid damage to lining by hot splatter. Protect tape coating similarly if external welding is required.
 7. Welding rods: Compatible with metal to be welded to obtain strongest bond, E-70XX.
 8. Deposit metal in successive layers to provide at least 2 passes or beads for automatic welding and 3 passes or beads for manual welding in completed weld.
 9. Deposit no more than 1/4 inch of metal on each pass. Thoroughly clean each individual pass with wire brush or hammer to remove dirt, slag or flux.
 10. Do not weld under weather condition that would impair strength of weld, such as wet surface, rain or snow, dust or high winds, unless work is properly protected.
 11. Make tack weld of same material and by same procedure as completed weld. Otherwise, remove tack welds during welding operation.
 12. Remove dirt, scale, and other foreign matter from inside piping before tying in sections, fittings, or valves.
 13. Welded Joints for Large Diameter Water Lines:
 - a. Furnish pipe with trimmed spigots and interior welds for 36-inch and larger pipe.
 - b. Use exterior welds for 30 inch and smaller.
 - c. Only one end may be miter cut. Miter end cuts of both ends of butt-welded joints may be used for joint deflections of up to 2 ½ degrees.
 - d. For large diameter water lines, employ an independent certified testing laboratory, approved by Owner's Representative, to perform weld acceptance tests on welded joints. Include cost of such testing and associated work to accommodate testing in contract unit price bid for water line. Furnish copies of test reports to Owner's Representative for review. Owner's Representative has final decision as to suitability of welds tested.
 - 1) Weld acceptance criteria:

- a) Conduct in accordance with ASTM E165- Standard Test Method for Liquid Penetrant Examination and ASTM E709 Standard Guide for Magnetic Particle Examination. Use X-ray methods for butt welds, for 100 percent of joint welds.
 - b) Examine welded surfaces for the following defects:
 - (1) Cracking
 - (2) Lack of fusion/penetration
 - (3) Slag which exceeds one-third (t) where (t) equals material thickness
 - (4) Porosity/Relevant rounded indications greater than 3/16 inch; rounded indication is one of circular or elliptical shape with length equal to or less than three times its width
 - (5) Relevant linear indications in which length of linear indication exceeds three times its width
 - (6) Four or more relevant 1/16-inch rounded indications in line separated by 1/16 inch or less edge to edge
14. After pipe is joined and prior to start of welding procedure, make spigot and bell essentially concentric by jacking, shimming, or tacking to obtain clearance tolerance around periphery of joint except for deflected joints.
15. Furnish each welder employed steel stencil for marking welds, so work of each welder can be identified. Mark pipe with assigned stencil adjacent to weld. When welder leaves job, stencil must be voided and not duplicated. Welder making defective welds must discontinue work and leave project site. Welder may return to project site only after recertification.
16. Provide cylindrical corrosion barriers for epoxy lined steel pipe 24-inch diameter and smaller, unless minimum wall thickness is 0.5 inches or greater.
- a. In addition to welding requirements contained here in Paragraph 3.06, conform to protection fitting manufacturer's installation recommendations.
 - b. Provide services of technical representative of manufacturer available on site at beginning of pipe laying operations. Representative to train welders and advise regarding installation and general construction methods. Welders must have 12 months prior experience installing protection fittings.
 - c. All steel pipe is to have cutback 3/4 inch to no greater than 1 inch of internal diameter coating from weld bevel.
 - d. Furnish steel fittings with cylindrical corrosion barriers with shop welded extensions to end of fittings. Extension length to measure no less than diameter of pipe. Shop apply lining in accordance with AWWA C 210 or AWWA C 213.
 - e. All steel pipe receiving field adjustments are to be cold cut using standard practices and equipment. No cutting using torch is to be allowed.

D. Harnessed Joints (Concrete Cylinder Pipe, Bar Wrapped Pipe):

- 1. Use of snap-ring type restrained joints on pipe is limited to 20-inch through 48-inch diameters.
- 2. Position snap-ring joint bolt on top (12 o'clock portion). Provide minimum 1/2-inch joint recess. Use joint "diapers" minimum of 12 inches wide.
- 3. For field adjustments with deflections beyond manufacturer's recommendations:
 - a. Field trim spigot.
 - b. Do not engage ring.
- 4. Harnessed joints are not permitted in areas defined on Drawings as potentially petroleum contaminated material, in tunnels, or at bend greater than 5 degrees.
- 5. Install harness type joints including snap rings at straight sections of pipe.

E. Restrained Joints

1. For existing water lines and water lines less than 16 inches in diameter, restrain pipe joints with concrete thrust blocks.
2. Thrust restraint lengths shown on Drawings are minimum anticipated lengths. These lengths are based on deflections indicated and on use of prestressed concrete cylinder pipe for large diameter lines and ductile iron pipe for small diameter lines. Adjustments in deflections or use of other pipe material may result in reduction or increase of thrust lengths. Perform calculations by pipe manufacturer to verify proposed thrust restraint lengths. Submit calculations for all pipe materials sealed by a registered Professional Engineer in State of Texas for review by Owner's Representative. Make adjustments in thrust restraint lengths at no additional cost to Owner.
3. Passive resistance of soil will not be permitted in calculation of thrust restraint.
4. For 16-inch lines and larger use minimum 16-foot length of pipe in and out of joints made up of beveled pipe where restraint joint lengths are not identified on Drawings. Otherwise, provide restraint joints for a minimum length of 16 feet on each side of beveled joints.
5. Installation.
 - a. Install restrained joints mechanism in accordance with manufacturer's recommendations.
 - b. Examine and clean mechanism; remove dirt, debris, and other foreign material.
 - c. Apply gasket and joint NSF 61 FDA food grade approved lubricant.
 - d. Verify gasket is evenly seated.
 - e. Do not over stab pipe into mechanism.
6. Prevent any lateral movement of thrust restraints throughout pressure testing and operation.
7. Place 2500 psi concrete conforming to Division 32, for blocking at each change in direction of existing water lines, to brace pipe against undisturbed trench walls. Finish placement of concrete blocking, made from Type I cement, 4 days prior to hydrostatic testing of pipeline. Test may be made 2 days after completion of blocking if Type II cement is used.

F. Joint Grout (Concrete Cylinder Pipe, Bar Wrapped Pipe, Steel Pipe):

1. Mix cement grout mixture by machine except when less than 1/2 cubic yard is required. When less than 1/2 cubic yard is required, grout may be hand mixed. Mix grout only in quantities for immediate use. Place grout within 20 minutes after mixing. Discard grout that has set. Retempering of grout by any means is not permitted.
2. Prepare grout in small batches to prevent stiffening before it is used. Do not use grout which has become so stiff that proper placement cannot be assured without rettempering. Use grout for filling grooves of such consistency that it will adhere to ends of pipe.
3. Surface Preparation: Remove defective concrete, laitance, dirt, oil, grease, and other foreign material from concrete surfaces with wire brush or hammer to sound, clean surface. Remove rust and foreign materials from metal surfaces in contact with grout.
4. Follow established procedures for hot and cold weather concrete placement.
5. Complete joint grout operations and backfilling of pipe trenches as closely as practical to pipe laying operations. Allow grouted exterior joints to cure at least 1 hour before compacting backfill.

6. Grouting exterior joint space: Hold wrapper in place on both sides of joint with minimum 5/8-inch-wide steel straps or bands. Place no additional bedding or backfill material on either side of pipe until after grout band is filled and grout has mechanically stiffened. Pull ends of wrapper together at top of pipe to form access hole. Pour grout down one side of pipe until it rises on other side. Rod or puddle grout to ensure complete filling of joint recess. Agitate for 15 minutes to allow excess water to seep through joint band. When necessary, add more grout to fill joint completely. Protect gap at top of joint band from backfill by allowing grout to stiffen or by covering with structurally protective material. Do not remove band from joint. Proceed with placement of additional bedding and backfill material.
 7. Interior Joints for Pipe 24 inches and Smaller: Circumferentially butter bell with grout prior to insertion of spigot, strike off flush surplus grout inside pipe by pulling filled burlap bag or inflated ball through pipe with rope. After joint is engaged, finish off joint grout smooth and clean. Use swab approved by Owner's Representative for 20-inch pipe and smaller.
 8. Protect exposed interior surfaces of steel joint bands by metallizing, by other approved coatings, or by pointing with grout. Joint pointing may be omitted on potable water pipelines if joint bands are protected by zinc metallizing or other approved protective coatings.
 9. Remove and replace improperly cured or otherwise defective grout.
 10. Strike off grout on interior joints and make smooth with inside diameter of pipe.
 11. When installed in tunnel or encasement pipe and clearance within casing does not permit outside grout to be placed in normal manner, apply approved flexible sealer, such as Flex Protex or equal, to outside joint prior to joint engagement. Clean and prime surfaces receiving sealer in accordance with manufacturer's recommendations. Apply sufficient quantities of sealer to assure complete protection of steel in joint area. Fill interior of joint with grout in normal manner after joint closure.
 12. Interior Joints for Water Lines 30 inches and Larger: Clean joint space, wet joint surfaces, fill with stiff grout and trowel smooth and flush with inside surfaces of pipe using steel trowel so that surface is smooth. Accomplish grouting at end of each work day. Obtain written acceptance from Owner's Representative of inside joints before proceeding with next day's pipe laying operation. During inspection, ensure no delamination of joint mortar has occurred by striking joint mortar lining with rubber mallet. Remove and replace delaminated mortar lining.
 13. Work which requires heavy equipment to be over water line must be completed before mortar is applied to interior joints.
- G. Large Diameter Water Main Joint Testing: In addition to testing individual joints with feeler gauge approximately 1/2 inch wide and 0.015-inch thick, use other joint testing procedure approved or recommended by pipe manufacturer which will help ensure watertight installation prior to backfilling. Perform tests at no additional cost to Owner.
- H. Make curves and bends by deflecting joints or other method as recommended by manufacturer and approved by Owner's Representative. Submit details of other methods of providing curves and bends which exceed manufacturer's recommended deflection prior to installation.
1. Deflection of pipe joints shall not exceed maximum deflection recommended by pipe manufacturer, unless otherwise indicated on Drawings.
 2. If deflection exceeds that specified but is less than 5 percent, repair entire deflected pipe section such that maximum deflection allowed is not exceeded.
 3. If deflection is equal to or exceeds 5 percent from that specified, remove entire portion of deflected pipe section, and install new pipe.
 4. Replace, repair, or reapply coatings and linings as required.

5. Assessment of deflection may be measured by Owner's Representative at location along pipe. Arithmetical averages of deflection or similar average measurement methods will not be deemed as meeting intent of standard.
 6. When rubber gasketed pipe is laid on curve, join pipe in straight alignment and then deflect to curved alignment.
- I. Closures Sections and Approved Field Modifications to Steel, Concrete Cylinder Pipe, Bar Wrapped Pipe and Fittings:
1. Apply welded-wire fabric reinforcement to interior and exterior of exposed interior and exterior surfaces greater than 6 inches in diameter. Welded-wire fabric: minimum W1; maximum spacing 2 inches by 4 inches; 3/8 inch from surface of steel plate or middle third of lining or coating thickness for mortar thickness less than 3/4 inch.
 2. Fill exposed interior and exterior surfaces with nonshrink grout.
 3. For pipe diameters 36 inches and greater, perform field welds on interior and exterior of pipe.
 4. For large diameter water lines, provide minimum overlap of 4 inches of butt strap over adjacent piece on butt-strap closures.

3.7 CATHODIC PROTECTION APPURTENANCES

- A. Where identified on Drawings, modify pipe for cathodic protection as detailed on Drawings and specified. Unless otherwise noted, provide insulation kits including test stations at connections to existing water system or at locations to isolate one type of cathodic system from another type, between water line, access manhole piping and other major openings in water line, or as shown on Drawings.
- B. Bond joints for pipe installed in tunnel or open cut, except where insulating flanges are provided. Weld strap or clip between bell and spigot of each joint or as shown on Drawings. No additional bonding required where joints are welded for thrust restraint. Repair coating As specified by appropriate AWWA standard, as recommended by manufacturer, and as approved by Owner's Representative.
- C. Bonding Strap or Clip: Free of foreign material that may increase contact resistance between wire and strap or clip.

3.8 SECURING, SUPPORTING AND ANCHORING

- A. Support piping as shown on Drawings and as specified in this Section, to maintain line and grade and prevent transfer of stress to adjacent structures.
- B. Where shown on Drawings, anchor pipe fittings and bends installed on water line by welding consecutive joints of pipe together to distance each side of fitting. Restrained length, as shown on Drawings, assumes that installation of pipe and subsequent hydrostatic testing begins upstream and proceed downstream, with respect to normal flow of water in pipe. If installation and testing differs from this assumption, submit for approval revised method of restraining pipe joints upstream and downstream of device used to test against (block valve, blind flange or dished head plug).
- C. Use adequate temporary blocking of fittings when making connections to distribution system and during hydrostatic tests. Use sufficient anchorage and blocking to resist stresses and forces encountered while tapping existing water line.

3.9 POLYETHYLENE WRAP FOR DUCTILE IRON PIPE

- A. Double wrap pipe and appurtenances (except fire hydrants and fusion bond or polyurethane coated fittings) with 8-mil polyethylene film.
- B. Do not use polyethylene wrap if pipe is cathodically protected.
- C. Conform to requirements of Division 33.

3.10 CLEANUP AND RESTORATION

- A. Provide cleanup and restoration crews to work closely behind pipe laying crews, and where necessary, during disinfection and hydrostatic testing, service transfers, abandonment of old water lines, backfill and surface restoration.
- B. Unless otherwise approved by Owner's Representative, comply with the following:
 - 1. Once water line is installed to limits approved in layout submitted, immediately begin preparatory work for disinfection effort.
 - 2. No later than three days after completing disinfection preparatory work, execute disinfection work.
 - 3. Immediately after transfer of services, begin abandonment of old water lines and site restoration.
 - 4. Do not exceed a total of 50% of total project linear feet of disturbed right-of-way and easement until site is restored in accordance with Division 1.
 - 5. Exceeding any of the above footage limitations shall be considered a material breach of the Contract and subject to termination in accordance with the General Conditions.
- C. For large diameter water lines, do not install more than 2,000 linear feet of water line, without previous 2,000 linear feet being restored in accordance with Division 1. Schedule paving crews so repaving work will not lag behind pipe laying work by more than 1,000 linear feet. Failure to comply with this requirement shall be considered a material breach of the Contract and subject to termination in accordance with the General Conditions.

3.11 CLEANING PIPING SYSTEMS

- A. Remove construction debris or foreign material and thoroughly broom clean and flush piping systems. Provide temporary connections, equipment, and labor for cleaning. Owner's Representative must inspect water line for cleanliness prior to filling.

3.12 DISINFECTION OF WATER LINES

- A. Conform to requirements of Division 33.

3.13 FIELD HYDROSTATIC TESTS

- A. Conform to requirements of Division 33.

END OF SECTION

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SECTION 33 11 00.10 - AUGERING FOR WATER UTILITY DISTRIBUTION PIPING

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Installing water service pipe by methods of augering or casing by jacking and boring.
- B. Specifications identify requirements for both small-diameter (less than or equal to 20 inches) water mains and large-diameter (greater than 20 inches) water mains. When specifications for large-diameter water mains differ from those for small-diameter water mains, paragraphs for large-diameter mains will govern for large-diameter pipe.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices.
 - 1. Measurement and payment for pipe installed shall be at the unit price contained in the bid proposal, for each linear foot of pipe installed, complete in place including furnishing of all materials, all equipment, tools, transportation, services, labor and superintendence necessary for the construction and completion of improvements, including fittings; sheeting, bracing, and supporting the adjacent ground of structure where necessary; handling all drainage or ground water; replacing damaged water and sewer service lines, conduits, ducts, etc.; backfilling the trench and pits; removing surplus excavated materials; sterilizing the completed pipelines; replacing street base and surfaces; and other incidentals required to complete the Work.
- B. Stipulated Price (Lump Sum). If the Contract is a Stipulated Price Contract, payment for work in this Section is included in the total Stipulated Price.

1.3 DEFINITIONS

- A. Dry Auger Method: Installation of steel casing by excavating soil at the advancing end of casing and transporting spoil through casing by an otherwise uncased auger, while advancing casing by jacking at same rate as auger excavation progresses.
- B. Slurry Auger Method: Installation of casing or pipe by first drilling a small diameter pilot hole from shaft to shaft, followed by reaming the bore to full diameter by auguring with slurry, and installing casing or pipe by a pull-back or jacking method.

1.4 REFERENCE STANDARDS

- A. ASTM D 638 - Test Method for Tensile Properties of Plastics.
- B. ASTM D 648 - Test Method for Deflection Temperature of Plastics Under Flexural Load.
- C. ASTM D 695 - Test Method for Compressive Properties of Rigid Plastics.
- D. ASTM D 790 - Test Method for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

1.5 REGULATORY REQUIREMENTS

- A. Conform to Texas State Department of Highways and Public Transportation for installations under state highways. Owner will obtain required permits for State Highway crossings.
- B. Installations Under Railroads:
 - 1. Secure and comply with requirements of right-of-entry for crossing railroad company's easement or right-of-way from railroad companies affected. Comply with railroad permit requirements.
 - 2. Use dry auger method only.
 - 3. No extra compensation for damages due to delays caused by the railroad requesting work to be done at hours which will not inconvenience the railroad.
 - 4. Maintain minimum 35-foot clearance from centerline of tracks.

1.6 SUBMITTALS

- A. Submit product data in accordance with requirements of Section 01 33 00 – Submittal Procedures.
- B. Submit product data for casing insulators for approval.
- C. Prior to commencement of work, furnish for Engineer's approval, a plan showing pit locations, size, depth, and areas for storage, material, and spoil handling. Approval of this plan does not relieve Contractor from responsibility to obtain specified results.
- D. Show actual pit locations dimensioned on as-built drawings so that they can be identified in field.
- E. Submit copy of railroad company permits and rights of entry to Engineer.

1.7 CRITERIA FOR SELECTION OF MATERIAL

- A. Contractor shall be responsible for selection of casing, pipe, and pipe joints to carry anticipated thrust of jacks or loads.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Piping and Fittings: As required by Specification or Drawings.
- B. Casings: Where shown on Drawings, in accordance with Section 33 11 00.10 - Steel Pipe and Fittings.
- C. Casing Spacers: Where casings are shown on Drawings, casing spacer width 8 inches for pipe sizes 4 to 14 inches; 12 inches for pipe sizes 16 to 30 inches.
 - 1. For welded steel pipe 12 inches and smaller, use Pipeline Seal & Insulator Model PE, or approved equal.
 - 2. For other pipe materials, use Pipeline Seal & Insulator Model C8G-2 or approved equal for pipe sizes up to 12 inches.
 - 3. For all pipe sizes above 12 inches, use Pipeline Seal & Insulator Model C12G-2 or approved equal.
- D. Casing End Seals: Provide Pipeline Seal and Insulator Model C, or approved equal.

- E. Casing Spacers (Additional Requirements for Large-Diameter Water Mains): Bolt-on style with shell made of two sections of 14-gauge carbon steel, hot rolled, pickled, and lined with PVC liner, 0.090 inch thick with Durometer A 85-90 overlapping edges to secure liner to spacer; deep embossed flanges for added strength; coated prior to installation of liner and runner with fusion-bonded powder of 14 to 20 mils thickness; electroplated studs, nuts, and washers.
- F. Runners (For Large-Diameter Water Mains): Supported by 10-gauge carbon steel MIG risers welded to shell. Minimum requirements:
 - 1. Tensile Strength: ASTM D 638; 17,600 psi.
 - 2. Flexural Strength: ASTM D 790; 25,300 psi.
 - 3. Compression Strength: ASTM D 695; 18,000 psi.
 - 4. Deflection Temperature at 264 psi: ASTM D 648; 405 F.

PART 3 EXECUTION

3.1 LIMITS ON AUGER LENGTH

- A. Do not exceed 100 feet for length of auger hole without intermediate pit.
- B. Do not exceed 75 feet for length of auger hole for PVC pipe 12 inches and less in diameter without intermediate pit.
- C. Do not exceed 40 feet for length of auger hole for PVC pipe 14 inches to 24 inches in diameter without intermediate pit.

3.2 PREPARATION

- A. Conform to applicable provisions of Section 31 06 20.17 – Utility Backfill Materials.
- B. Utility Relocations: Relocate utility lines clear of pit and zone of potential significant settlement or other ground disturbance.
- C. Install casings as required by Drawings, in accordance with this Section.
- D. Install temporary solid plug at open end of water main to prevent contamination.

3.3 TRAFFIC CONTROL

- A. Conform to applicable provisions of Section 01570 - Traffic Control and Regulation.
- B. Secure right-of-entry for crossing railroad company's easement or right-of-way.
- C. During construction operations, furnish, and maintain barricades and lights to safeguard traffic and pedestrians, until such time as backfill has been completed and removed from site. Provide additional barricades and lights as directed by Engineer.

3.4 PITS

- A. Construct pits on segments of line and within right-of-way. Locate auger pits where there is minimum interference with traffic or access to property. Do not locate pits close to storm drainage channels, ditches, storm water lines, or culverts. Avoid pit locations near potentially contaminated areas.

- B. Pit Size: Size pits to provide adequate room to meet operational requirements for auger construction as well as any structures indicated on the Drawings. Provide minimum 6-inch space between pipe and walls of bore pit. Maximum allowable width of pit shall be 5 feet. Width of pit at surface shall not be less than at bottom. Maximum allowable length of pit shall be no more than 5 feet longer than one full joint of pipe and shall not exceed 25 feet.
- C. Excavate bore pits to finished grade at least 6 inches lower than grade indicated by stakes.
- D. Backfill in accordance with Section 31 06 20.17 – Utility Backfill Materials.
- E. Auger pits that are excavated and backfilled as part of open-cut water line construction shall be in accordance with Section 31 06 20.17 – Utility Backfill Materials.
- F. The provisions for safety protection against traffic, and accidental or unauthorized entry, as specified in Section 02445 - Tunnel Shafts, shall be followed in applicable situations.
- G. Install sheeting, lining, shoring, and bracing required for protection of the workmen and the public in accordance with Section 01 35 26 - Trench Safety Systems.

3.5 AUGERING (BORING)

- A. Auger from approved pit locations. Excavate for pits and install shoring as outlined above under Paragraph 3.7, Pits. Auger mechanically with use of a pilot hole entire length of crossing and check for line and grade on opposite end of bore from work pit. The large hole is to be no more than 2 inches larger than diameter of bell. Place excavated material outside working pit and dispose of as specified. Use water or other fluids in connection with boring operation only to lubricate cuttings; jetting is not permitted.
- B. In unconsolidated soil formations, a gel-forming colloidal drilling fluid may be used. Fluid is to consist of at least 10 percent of high-grade processed bentonite and shall consolidate cuttings of bit, seal walls of hole, and shall furnish lubrication for subsequent removal of cuttings and installation of pipe.
- C. Depending on the character of the soil encountered during the augering operation, conduct operations without interruption, insofar as practical, to prevent the hole from collapsing or the pipe from seizing up in the hole before the installation is complete.
- D. Allowable variation from line and grade shall be as specified under Paragraph 3.07, Jacking Casing.
- E. Remove and replace any pipe damaged in augering operations.

3.6 FILLING ANNULAR SPACE

- A. For installation of water main, block void space around pipe in augered hole with approximately 12 inches of packed clay or approved equal material to prevent bedding or backfill from entering the void around the pipe in the augered hole when compacted. For pipe diameters 4 inches through 8 inches use minimum 1/2-cubic-foot clay; for pipe diameters 12 inches through 16 inches use minimum 3/4-cubic-foot clay.

3.7 JACKING CASING

- A. Comply with Section 01 35 26 - Trench Safety Systems for all pits, access shafts, end trenches, and other excavations relating to work required by specifications. Dewater as required to provide safe working conditions.

- B. If grade of casing at jacking end is below ground surface, excavate pits or trenches for conducting jacking operations and for placing end joints of casing. Wherever end trenches are cut into sides of embankment or beyond it, sheath securely and brace such work to prevent earth caving.
- C. Make up only one joint at a time in pit or trench prior to jacking.
- D. Do not interfere with operation of railroad, street, highway, or other facility, nor to weaken or damage embankment or structure.
- E. Use heavy-duty jacks sized for forcing casing through embankment. Use appropriate jacking head, usually of timber, and bracing between jacks and jacking head and jacking frame or backstop. Apply jacking pressure uniformly around ring of casing. Set casing to be jacked on guides, properly braced together, to support section of casing and to direct it in proper line and grade. Place jacking assembly in line with direction and grade of casing. Excavate embankment material just ahead of casing and remove material through casing. Force casing through embankment with jacks into excavated auger hole.
- F. Conform excavation for underside of casing to contour and grade of casing, for at least one third of circumference of casing. Provide clearance of not more than 2 inches for upper half of casing. Taper off upper clearance to zero at point where excavation conforms to contour of casing.
- G. The excavation may extend beyond end of casing depending on character of material, but shall not exceed 2 feet in any case. Decrease advance excavation at the direction of the Engineer, if character of material being excavated makes it desirable to keep advance excavation closer to end of casing.
- H. Jack casing from low or downstream end. Lateral or vertical variation in final position of casing from line and grade as shown on Drawings will be permitted only to extent of 1 inch in 10 feet, provided such variation is regular and only in one direction and that final grade of flow line is in direction indicated on Drawings.
- I. Use cutting edge of steel plate around head end of casing extending short distance beyond end of casing with inside angles or lugs to keep cutting edge from slipping back onto casing.
- J. Once jacking of casing is begun, carry on without interruption, insofar as practicable, to prevent casing from becoming firmly set in embankment.
- K. Remove and replace any casing damaged in jacking operations.
- L. Backfill pits or trenches excavated to facilitate jacking operations immediately after completion of jacking of casing.
- M. Grout annular space between casing and excavated hole when loss of embankment occurs or when clearance of 2 inches is exceeded.

3.8 SPACER INSTALLATION

- A. There must be no inadvertent metallic contact between casing and carrier pipe. Spacing of spacers should ensure that carrier pipe is adequately supported throughout its length, particularly at ends, to offset settling and possible electrical shorting. Place end spacer within 6 inches of end of casing pipe, regardless of size of casing and carrier pipe or type of spacer used. Spacing between spacers depends largely on load bearing capabilities of pipe coating and flexibility of pipe.

- B. Grade bottom of trench adjacent to each end of casing to provide firm, uniform, and continuous support for carrier pipe. If trench requires some backfill to establish final trench bottom grade, place backfill material in 6-inch lifts and compact to the density of undisturbed soil.
- C. Install casing spacers in accordance with manufacturer's instructions. Take special care to ensure that subcomponents are correctly assembled and evenly tightened, and that no damage occurs during tightening of insulators or carrier pipe insertion.
- D. Seal annulus between carrier pipe and casing with casing end seals at each end of casing.
- E. Insulator Spacing:
 - 1. Spacing shall be as shown on Drawing with maximum distance between spacers to be 10 feet for pipe sizes 4 to 14 inches and 8 feet for pipe sizes 16 to 30 inches.
 - 2. For ductile iron pipe, flanged pipe, or bell-and-spigot pipe, spacers shall be installed within one foot on each side of bell or flange and one in center of joint when 18- to 20-foot-long joints are used.
 - 3. If casing or carrier pipe is angled, bent, or dented, reduce spacing as directed by Engineer.

3.9 SETTLEMENT SURVEYING

- A. Record the ground surface elevation ahead of the augering operation. Record the elevation of each survey point with an accuracy of 0.01 feet. Locate survey points as follows:
 - 1. Railroads. Track subbase at centerline of each track.
 - 2. Pipeline crossings. Directly above and 10 feet before and after the crossing.
- B. Report settlement observations daily to Engineer and continue until any noticeable settlement has stopped. In the case of observed settlement, increase the monitoring points and observation frequency, as requested by Engineer.

3.10 CLEANUP

- A. Conform to applicable provisions of Section 02 41 13.11 – Construction Waste Management and Disposal.

END OF SECTION

SECTION 33 12 13.10 – TAPPING SLEEVES AND VALVES

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Tapping sleeves and valves for connections to existing water system.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices:
 - 1. Payment for tapping sleeves and valves will be on a unit price basis for each tapping sleeve and valve installed.
- B. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 REFERENCES

- A. ASTM A240 - Standard Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels.
- B. ASTM A193 Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service.
- C. ASTM A194 Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure or High-Temperature Service.
- D. AWWA C 110 - Standard for Ductile-Iron and Gray-Iron Fittings, 3 in. through 48 in., for Water and other Liquids.
- E. AWWA C 200 - Standard for Steel Water Pipe - 6 in. and Larger.
- F. AWWA C 207 - Standard for Steel Pipe Flanges for Waterworks Service - Sizes 4 in. through 144 in.
- G. AWWA C 500 - Standard for Metal Seated Gate Valves, for Water Supply Service.

1.4 SUBMITTALS

- A. Conform to requirements of Division 1.
- B. Submit results of tapping sleeves NPT test opening.
- C. Submit manufacturer's affidavit as required in Division 1.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Ship steel sleeves in wooden crates that provide protection from damage to epoxy coating during transport and storage.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Tapping Sleeves:
1. Tapping Sleeve Bodies: AWWA C 110 cast or ductile iron or AWWA C 200 carbon steel in two sections to be bolted together with high-strength, corrosion-resistant, low-alloy steel bolts with mechanical joint ends.
 2. Branch Outlet of Tapping Sleeve:
 - a. Flanged, machined recess, AWWA C 207, Class D, ANSI 150 pound drilling.
 - b. Gasket: Affixed around recess of tap opening to prevent rolling or binding during installation.
 3. Use cast iron split sleeve where fire service from 6-inch water line is approved.
- B. Welded-steel tapping-sleeve bodies may be used in lieu of cast or ductile iron bodies for following sizes and with following restrictions:
1. Flange: AWWA C 207, Class D, ANSI 150 pound drilling.
 2. Gasket: Affixed around recess of tap opening to prevent rolling or binding during installation.
 3. Steel sleeves are restricted to use on pipe sizes 6 inches and larger.
 4. Body: Heavy, welded-steel construction; top half grooved to retain neoprene O-ring seal permanently against outside diameter of pipe.
 5. Bolts: AWWA C 500 Section 3.5; coated with 100 percent vinyl resin or corrosive resistant material.
 6. Steel Sleeves Finish: Fusion-bonded epoxy coated to minimum 12 mil thickness.
 7. Finished Epoxy Coat: Free of laminations and blisters; and remain pliant and resistant to impact with non-peel finish.
 8. Provide approved steel tapping sleeves.
 9. Tapping Sleeves: Provide with 3/4-inch NPT test opening for testing prior to tapping. Provide 3/4-inch bronze plug for opening.
 10. Do not use steel sleeves for taps greater than 75 percent of pipe diameter.
- C. Stainless Steel tapping-sleeve bodies and flange may be used in lieu of cast or ductile iron bodies for following sizes and with following restrictions:
1. Flange: ASTM A240 Stainless Steel, Type 304, ANSI 150 pound drilling.
 2. Gasket: Full circumferential, affixed around recess of tap opening to prevent rolling or binding during installation, compounded for water and sewer service.
 3. Stainless Steel sleeves are restricted to use on pipe sizes 4 inches and larger.
 4. Body: ASTM A240 Stainless Steel, Type 304.
 5. Bolts: ASTM A193 Stainless Steel, Type 304.
 6. Nuts: ASTM A194 Stainless Steel, Type 304.
 7. Branch Outlet: Heavy Stainless Steel Pipe.
 8. Provide approved stainless steel tapping sleeves.
 9. Do not use stainless steel sleeves for taps greater than 75 percent of pipe diameter.
- D. Tapping Valves: Meet requirements of Division 33 with following exceptions:
1. Inlet Flanges:
 - a. AWWA C 110; Class 125.
 - b. AWWA C 110; Class 150 and higher: Minimum 8-hole flange.
 2. Outlet: Standard mechanical or push-on joint to fit any standard tapping machine.
 3. Valve Seat Opening: Accommodate full-size shell cutter for nominal size tap without contact with valve body; double disc.

- E. Valve Boxes: Standard Type "A" valve boxes conforming to requirements of Division 33.

PART 3 EXECUTION

3.1 APPLICATION

- A. Install tapping sleeves and valves at locations and of sizes shown on Drawings. Install sleeve so valve is in horizontally level position unless otherwise indicated on Drawings.
- B. Clean tapping sleeve, tapping valve, and pipe prior to installation and in accordance with manufacturer's instructions.
- C. Hydrostatically test installed tapping sleeve to 150 psig for minimum of 15 minutes. Inspect sleeve for leaks, and remedy leaks prior to tapping operation.
- D. When tapping concrete pressure pipe, size on size, use shell cutter one standard size smaller than water line being tapped.
- E. Do not use Large End Bell (LEB) increasers with next size tap unless existing pipe is asbestos-cement.

3.2 INSTALLATION

- A. Verify outside diameter of pipe to be tapped prior to ordering sleeve.
- B. Tighten bolts in proper sequence so that undue stress is not placed on pipe.
- C. Align tapping valve properly and attach to tapping sleeve. Insert insulation sleeves into flange holes of tapping valve and pipe. Make insertions of sleeves on pipe side of tapping valve. Do not damage insulation sleeves during bolt tightening process.
- D. Make tap with sharp, shell cutter:
 - 1. For 12-inch and smaller tap, use minimum cutter diameter one-half inch less than nominal tap size.
 - 2. For 16-inch and larger tap, use manufacturer's recommended cutter diameter.
- E. Withdraw coupon and flush cuttings from newly made tap.
- F. Wrap:
 - 1. For 12-inch and smaller tap, wrap completed tapping sleeve and valve in accordance with Division 2.
 - 2. For 16-inch and larger tap, apply coal tar epoxy around completed tapping sleeve and valve. The coal tar epoxy shall be applied with minimum of two (2) coats. Each coat of coal tar epoxy shall have minimum dry film thickness of 16 mils.
- G. Place concrete thrust block behind tapping sleeve (not over tapping sleeve and valve).
- H. Request inspection of installation prior to backfilling.
- I. Backfill in accordance with Division 31.

END OF SECTION

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SECTION 33 12 13.12 - WET CONNECTIONS

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Wet connections for new water mains and service lines to existing water mains.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices:
 - 1. Payment for wet connections are on a unit price basis for each wet connection made.
- B. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for work in this Section is included in the total Stipulated Price.

1.3 REFERENCES

- A. AWWA C 800 - Underground Service Line Valves and Fittings.

1.4 DEFINITIONS

- A. Wet connections consist of isolating sections of pipe to be connected with installed valves, draining the isolated sections, and completing the connections.
- B. Connection of 2-inch or smaller lines, which may be referred to on Drawings as "2-inch standard connections" or "gooseneck connections" will be measured as 2-inch wet connections. This item is not to be used as part of a 2-inch service line.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Pipe shall conform to requirements of applicable portions of Division 33 related to piping materials and to water distribution.
- B. Corporation cocks and saddles shall conform to requirements in Division 33.
- C. Valves shall conform to requirements of Section 33 12 16 – Water Utility Distribution Valves.
- D. Brass fittings shall conform to requirements of AWWA C 800.

PART 3 EXECUTION

3.1 CONNECTION OPERATIONS

- A. Plan wet connections in such manner and at such hours as to least inconvenience public. Notify Engineer at least 48 hours in advance of making connections.
- B. Do not operate valves on mains in use by Owner. Owner Representative will handle, at no cost to Contractor, operations involving opening and closing valves for wet connections.

- C. Conduct connection operations when Owner Representative is at job site. Connection work shall progress without interruption until complete once existing mains have been cut or plugs has been removed for making connections.

3.2 2-INCH WET CONNECTIONS

- A. Tap water main. Use corporation cocks, saddles, copper tubing as required for line and grade adjustment, and brass fittings necessary to adapt to existing main. Use 2-inch valves when indicated on Drawings for 2-inch copper gooseneck connections.

END OF SECTION

SECTION 33 12 16 - WATER UTILITY DISTRIBUTION VALVES

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Gate valves.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices:
 - 1. Payment for water utility distribution valves is on a unit price basis for each valve installed.
- B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 REFERENCES

- A. ASTM A 307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile.
- B. ASTM B 62 - Standard Specification for Composition Bronze or Ounce Metal Casting.
- C. ASTM D 429 - Standard Test Methods for Rubber Property-Adhesion to Rigid Substrates.
- D. ASTM B 763 - Standard Specification for Copper Alloy Sand Casting for Valve Application.
- E. AWWA C 500 - Standard for Metal-Seated Gate Valves for Water Supply Service.
- F. AWWA C 509 - Standard for Resilient-Seated Gate Valves for Water Supply Service.
- G. AWWA C 515- Standard for Reduced Wall, Resilient- Seated Gate Valves for Water Supply Service.
- H. AWWA C 550 - Standard for Protective Epoxy Interior Coatings for Valves and Hydrants.

1.4 SUBMITTALS

- A. Conform to requirements of Division 1.
- B. Submit manufacturer's product data for proposed valves for approval.
- C. Provide detailed drawings of gearing mechanism for 20-inch and larger gate valves.

1.5 QUALITY CONTROL

- A. Submit manufacturer's affidavit that gate valves are manufactured in the United States and conform to stated requirements of AWWA C 500, AWWA C 509, AWWA C 515, and this Section, and that they have been satisfactorily tested in the United States in accordance with AWWA C 500, AWWA C 509, and AWWA C 515.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Gate Valves: AWWA C 500, AWWA C 509, AWWA C 515 and additional requirements of this Section. Direct bury valves and those in subsurface vaults open clockwise; aboveground and plant valves open counterclockwise.
- B. If type of valve is not indicated on Drawings, use gate valves as line valves for sizes 20-inches and smaller. When type of valve is indicated, no substitute is allowed.
- C. Gate Valves 1-1/2 inches in Diameter and Smaller: 125 psig; bronze; rising-stem; single-wedge; disc type; screwed ends.
- D. Coatings for Gate Valves 2 inches and larger: AWWA C 550 non-toxic, imparts no taste to water, functions as physical, chemical, and electrical barrier between base metal and surroundings, minimum 8-mil-thick, fusion-bonded epoxy. Prior to assembly of valve, apply protective coating to interior and exterior surfaces of body.
- E. Gate Valves 2 inches in diameter: Iron body, double disc, or resilient-seated, non-rising stem, 150-pound test, 2-inch square nut operating clockwise to open.
- F. Gate Valves 3 inches to 12 inches in diameter: Non-directional, standard-wall resilient seated (AWWA C 509), parallel seat double disc (AWWA C 500), or reduced-wall resilient seated gate valves (AWWA C 515), 200 psig pressure rating, bronze mounting, push-on bell ends with rubber joint rings, and nut-operated unless otherwise specified. Provide approved standard-wall resilient seated valves. Provide approved reduced-wall resilient seated valves. Provide approved double disc valves. Comply with following requirements unless otherwise specified in Drawings:
 - 1. Design: Fully encapsulated rubber wedge or rubber seat ring mechanically attached with minimum 304 stainless-steel fasteners or screws; threaded connection isolated from water by compressed rubber around opening.
 - 2. Body: Cast or ductile iron, flange bonnet and stuffing box together with ASTM A 307 Grade B bolts. Manufacturer's initials, pressure rating, and year manufactured shall be cast in body.
 - 3. Bronze: Valve components in waterway to contain not more than 15 percent zinc and not more than 2 percent aluminum.
 - 4. Stems: ASTM B 763 bronze, alloy number-995 minimum yield strength of 40,000 psi; minimum elongation in 2-inches of 12 percent, non-rising.
 - 5. O-rings: For AWWA C 500, Section 3.12.2. For AWWA C 509, Sections 2.2.6 and 4.8.2. For AWWA C 515, Section 4.2.2.5.
 - 6. Stem Seals Consist of three O-rings, two above and one below thrust collar with anti-friction washer located above thrust collar for operating torque.
- G. Stem Nut: Independent or integrally cast of ASTM B 62 bronze.
- H. Resilient Wedge: Molded, synthetic rubber, vulcanized and bonded to cast or ductile iron wedge or attached with 304 stainless steel screws tested to meet or exceed ASTM D 429 Method B; seat against epoxy-coated surface in valve body.
- I. Bolts: AWWA C 500 Section 3.4, AWWA C 509 Section 4.4 or AWWA C 515 Section 4.4.4; stainless steel; cadmium plated, or zinc coated.

- J. Gate valves 14 inch and larger in Diameter: AWWA C 500; parallel seat double disc gate valves; push-on bell ends with rubber rings and nut-operated unless otherwise specified. Provide approved double disc valves with 150 psig pressure rating. Comply with following requirements unless otherwise specified on Drawings:
1. Body: Cast iron or ductile iron; flange together bonnet and stuffing box with ASTM A 307 Grade B bolts. Cast following into valve body manufacturer's initials, pressure rating, and year manufactured. When horizontally mounted, equip valves greater in diameter than 12 inches with rollers, tracks, and scrapers.
 2. O rings: For AWWA C 500, Section 3.12.2. For AWWA C 515, Section 4.2.2.5.
 3. Stems: ASTM B 763 bronze, alloy number-995 minimum yield strength of 40,000 psi; minimum elongation in 2-inches of 12 percent, non-rising.
 4. Stem Nut: Machined from ASTM B 62 bronze rod with integral forged thrust collar machined to size; non-rising.
 5. Stem Seals: Consist of three O-rings, two above and one below thrust collar with anti-friction washer located above thrust collar for operating torque.
 6. Bolts: AWWA C 500 Section 3.4 or AWWA C 515 Section 4.4.4; stainless steel; cadmium plated, or zinc coated.
 7. Discs: Cast iron with bronze disc rings securely pinned into machined dovetailed grooves.
 8. Wedging Device: Solid bronze or cast-iron, bronze-mounted wedges. Thin plates or shapes integrally cast into cast-iron surfaces are acceptable. Other moving surfaces integral to wedging action shall be bronze monel or nickel alloy-to-iron.
 9. Provide bypass for valves 24 inches and larger.
 10. Bronze Mounting: Built as integral unit mounted over, or supported on, cast-iron base and of sufficient dimensions to be structurally sound and adequate for imposed forces.
 11. Gear Cases: Cast iron; furnished on 18-inch and larger valves and of extended type with steel side plates, lubricated, gear case enclosed with oil seal or O-rings at shaft openings.
 12. Stuffing Boxes: Located on top of bonnet and outside gear case.
- K. Gate valves 14 inches to 24 inches: Provide AWWA C 515; reduced-wall, resilient seated gate valves with 250 psig pressure rating. Furnish with spur or bevel gearing.
1. Mount valves horizontally if proper ground clearance cannot be achieved by normal vertical installation. For horizontally mounted gate valves, provide bevel operation gear mounted vertically for above ground operation.
 2. Use valve body, bonnet, wedge, and operator nut constructed of ductile iron. Fully encapsulate exterior of ductile iron wedge with rubber.
 3. Ensure wedge is symmetrical and seals equally well with flow in either direction.
 4. Provide ductile iron operator nut with four flats at stem connection to apply even input torque to the stem.
 5. Bolts: AWWA C515, Section 4.4.4, Stainless Steel; cadmium plated, or zinc coated.
 6. Provide high strength bronze stem and nut.
 7. O-rings: AWWA C515, Section 4.2.2.5, pressure O-rings as gaskets.
 8. Provide stem sealed by three O-rings. Top two O-rings are to be replaceable with valve fully open at full rated working pressure.
 9. Provide thrust washers to the thrust collar for easy valve operation.
- L. Gate Valves Extension Stem: When shown on Drawings, provide non-rising, extension stem having coupling sufficient to attach securely to operating nut of valve. Upper end of extension stem shall terminate in square wrench nut no deeper than 4 feet from finished grade or as shown on Drawings. Support extension stem with an arm attached to wall of manhole or structure that loosely holds extension stem and allows rotation in the axial direction only.

- M. Gate Valves in Factory Mutual (Fire Service) Type Meter Installations: Conform to provisions of this specification; outside screw and yoke valves; carry label of Underwriters' Laboratories, Inc.; flanged, Class 125; clockwise to close.
- N. Gate Valves for Tapping Steel Pipe: Provide double disc gate valve. Resilient wedge gate valve shall only be installed in a vertical position.
- O. Provide flanged joints when valve is connected to steel or PCCP.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Earthwork. Conform to applicable provisions of Division 31.
- B. Operation. Do not use valves for throttling without prior approval of manufacturer.

3.2 SETTING VALVES AND VALVE BOXES

- A. Remove foreign matter from within valves prior to installation. Inspect valves in open and closed positions to verify that parts are in satisfactory working condition.
- B. Install valves and valve boxes where shown on Drawings. Set valves plumb and as detailed. Center valve boxes on valves. Carefully tamp earth around each valve box for minimum radius of 4 feet, or to undisturbed trench face when less than 4 feet. Install valves completely closed when placed in water line.
- C. For pipe section of each riser, use only 6 inch, ductile iron Class 51, or DR18 PVC pipe cut to proper length. Riser must be installed to allow complete access for operation of valve.
- D. Assemble and brace box in vertical position as indicated on Drawings.

3.3 DISINFECTION AND TESTING

- A. Assist Owner's Representative with disinfection of valves and appurtenances as required by Division 33 and test as required by Division 33.
- B. Double-Disc Gate Valves: Apply hydrostatic test pressure equal to twice rated working pressure of valve between discs. Valve shall show no leakage through metal, flanged joints, or stem seals. Test at rated working pressure, applied between discs. Valve shall show no leakage through metal, flanged joints, or stem seals. Do not exceed leakage rate of 1 oz/hr/inch of nominal valve size.
- C. Solid-Wedge Gate Valves: Apply hydrostatic pressure equal to twice rated working pressure of valve with both ends bulkheaded and gate open. Valve shall show no leakage through metal, flanged joints, or stem seals. Test at rated working pressure, applied through bulkheads alternately to each side of closed gate with opposite side open for inspection. Valve shall show no leakage through metal, flanged joints, or stem-seals. Do not exceed leakage rate of 1 oz/hr/inch of nominal valve size.
- D. Repair or replace valves which exceed leakage rate.

3.4 PAINTING OF VALVES

- A. Paint valves in vaults, stations, and above ground with approved paint.

END OF SECTION

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SECTION 33 12 40 - VALVE BOXES, METER BOXES, AND METER VAULTS

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Valve boxes for water service.
- B. Meter boxes for water service.
- C. Meter vaults for water service.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices:
 - 1. No separate payment will be made for valve boxes under this Section. Include payment in unit price for Section 02570 - Water Mains.
 - 2. No separate payment will be made for meter boxes under this Section. Include payment in unit price for Section 02512 - Water Tap and Service Line Installation.
 - 3. Payment for meter vaults is on a unit price basis per vault. Payment will be made for each vault installed regardless of depth.
- B. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 REFERENCES

- A. ASTM A 48 - Standard Specification for Gray Iron Castings.
- B. ASTM D 256 - Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics.
- C. ASTM D 638 - Standard Test Method for Tensile Properties of Plastics.
- D. ASTM D 648 - Standard Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position.
- E. ASTM D 790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
- F. ASTM D 2240 - Standard Test Method for Rubber Property-Durometer Hardness.

1.4 SUBMITTALS

- A. Conform to requirements of Division 1.
- B. Submit manufacturers' product data for following items for approval:
 - 1. Each type of valve box and lid.
 - 2. Each type of meter box and cover.
 - 3. Each type of meter vault frame and cover.
- C. Submit design calculations and shop drawings for precast vault elements, sealed by an Engineer registered in State of Texas.

- D. Submit shop drawings for cast-in-place meter vaults for approval if proposed construction varies from Drawings.
- E. Submit manufacturer's certification that plastic meter boxes meet requirements of Paragraph 2.05, Plastic Meter Boxes.

PART 2 PRODUCTS

2.1 VALVE BOXES

- A. Provide approved Type A, cast-iron/ductile-iron, slide-type, valve boxes. Design of valve box shall minimize stresses on valve imposed by loads on box lid. In grassy areas, top of valve box to be set 4" above finished grade if more than 20' from existing or proposed sidewalk. Otherwise, top of valve box to be flush with finished grades.
- B. Cast letter "W" into lid, 1/2 inch in height and raised 3/32 inch, for valves serving potable water lines.
- C. Unless otherwise specified, uncoated cast iron.
- D. Riser Pipe.
 - 1. Provide 6-inch PVC, Class 150, DR 18, riser pipes in accordance with Division 33 or
 - 2. 6-inch ductile-iron, thickness Class 51 riser pipes in accordance with Division 33.
 - 3. Provide single section of pipe.
- E. Concrete for valve box placement:
 - 1. For locations in new concrete pavement, provide strength and mix design of new pavement.
 - 2. For other locations, provide concrete for sidewalks conforming to requirements of Division 32.

2.2 METER BOXES

- A. Provide meter boxes as required by the governing authority and as shown on the drawings.

2.3 CAST-IRON METER BOXES

- A. Cast-Iron Boxes: Clean and free from sand blow-holes or other defects conforming to requirements of ASTM A 48, Class 30B. Bearing surfaces shall be machined so that covers seat evenly in frames.
- B. Boxes and lids shall have dipped, coal-tar-pitch, varnish finish.
- C. Provide lock-type meter boxes when required by Drawings. Lock mechanisms shall work with ease.

2.4 CONCRETE METER BOXES

- A. Concrete Meter Boxes: Made of Class A concrete, with minimum 4000 psi compressive strength, conforming to requirements of Division 32. Construct to dimensions shown on Drawings.
- B. Castings: Free from fractures, large or deep cracks, blisters or surface roughness or any other defects that may affect serviceability.

2.5 PLASTIC METER BOXES

- A. Plastic Meter Boxes: Made of high density polyethylene conforming to the following ASTM standards:

| ASTM | REQUIREMENT |
|--------|---|
| D 256 | Impact Strength = 1/9 ft.-lb./inch (Izod, Notched) |
| D 256 | Impact Strength – 6.4 ft.-lb./inch (Izod, Un-Notched) |
| D 638 | Tensile Strength (2.0 min.) = 3400 psi |
| D 648 | Deflection Temperature = 170 degrees F |
| D 2240 | Shore D, Hardness, 55-65 Impact Strength, Falling Dart Method, 160 inch-lb. |
| D 790 | Flexural Modulus = 90,000 psi |

- B. Meter boxes shall meet the following test requirements:
 - 1. Static Load: Not less than 2500 pounds using 6-inch disc with direct compression exerted at center of top of meter box with solid plastic lid.
 - 2. Deflection: Not less than 1000 pounds load required to deflect top edge of meter box 1/8- inch.
 - 3. Meter box body, without lid, shall weigh approximately 7 pounds.

2.6 METER VAULTS

- A. Meter vaults may be constructed of precast concrete, cast-in-place concrete, or common brick masonry unless a specific type of construction is required by Drawings.
- B. Concrete for Meter Vaults: Class A concrete, conforming to requirements of Division 32 with minimum compressive strength of 4000 psi at 28 days.
- C. Reinforcing steel for meter vaults: Conform to requirements of Division 32.
- D. Grates and Covers: Conform to requirements of Division 33.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Obtain approval from Owner's Representative for location of meter vault.
- B. Verify lines and grade are correct.
- C. Verify compacted subgrade will support loads imposed by vaults.

3.2 VALVE BOXES

- A. Install riser pipe with suitable length for depth of cover indicated on Drawings or to accommodate actual finish grade.
 - 1. Install with bell on top of valve.
 - 2. Place riser pipe in plumb, vertical position.
- B. Install valve box and riser piping plumbed in a vertical position. Provide 6-inches telescoping freeboard space between riser pipe top butt end, and interior contact flange of valve box, for vertical movement damping. End of pipe resting on valve shall be notched out sufficiently to provide a snug fit around the valve bonnet and to center valve inside of pipe.
- C. Set, align, and adjust valve box so that lid is level with final grade.
- D. Paint covers of new valve boxes in fluorescent orange when installed. After completion and acceptance by Owner, repaint covers black.

3.3 METER BOXES

- A. Install cast iron or plastic boxes in accordance with manufacturer's instructions.
- B. Construct concrete meter boxes to dimensions shown on Drawings.
- C. Adjust top of meter boxes to conform to cover elevations specified in Paragraph 3.05, Frame and Cover for Meter Vaults.
- D. Do not locate under paved areas unless approved by Owner's Representative. Use approved traffic-type box with cast iron lid when meter must be located in paved areas.

3.4 METER VAULTS

- A. Construct concrete meter vaults to dimensions shown on Drawings. Do not cast in presence of water. Make bottom uniform. Verify lines and grades are correct and compacted subgrade will support loads imposed by vaults.
- B. Precast Meter Vaults:
 - 1. Install precast vaults in accordance with manufacturer's recommendations. Set level on a minimum 3-inch-thick bed of sand conforming to requirements of Division 31.
 - 2. Seal lifting holes with cement-sand mortar or non-shrink grout.
- C. Meter Vault Floor Slab:
 - 1. Construct floor slabs of 6-inch-thick reinforced concrete. Slope floor 1/4 inch per foot toward sump. Make sump 12 inches in diameter, or 12 inches square, and 4 inches deep, unless other dimensions are required by Drawings. Install dowels at maximum of 18 inches, center-to-center for keying walls to floor slab.
 - 2. Precast floor slab elements may be used for precast vault construction.
- D. Cast-in-Place Meter Vault Walls:
 - 1. Key walls to floor slab and form to dimensions shown on Drawings. Minimum wall thickness shall be 4 inches.

2. Cast walls monolithically. One cold joint will be allowed when vault depth exceeds 12 feet.
3. Set frame for cover in concrete.

3.5 FRAME AND COVER FOR METER VAULTS

- A. Set cast iron frame in a mortar bed and adjust elevation of cover as follows:
 1. In unpaved areas, set top of meter box or meter vault cover 2 to 3 inches above natural grade.
 2. In paved areas, set top of meter box or meter vault cover flush with adjacent concrete but no higher than 1/2-inch.

3.6 BACKFILL

- A. Provide bank run sand in accordance with Division 31 and backfill and compact in accordance with Division 31.
- B. In unpaved areas, slope backfill around meter boxes and vaults to provide a uniform slope 1-to-5 slope from top to natural grade.
- C. In paved areas, slope concrete down from meter box or vault to meet adjacent paved area.

END OF SECTION

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SECTION 33 12 50 - FIRE HYDRANTS

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Fire hydrant construction, valves, and fittings.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices
 - 1. No separate payment will be made for PVC pipe under this section. Include cost in unit price for related work.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Fire Hydrants:
 - 1. Certified fire hydrants shall conform to the requirements and tests for American Water Works Association (AWWA) Standard C502-80, or latest revision thereof, entitled, AAWWA Standard for Dry-Barrel Fire Hydrants@ as to their design, component materials, construction, manufacture and testing except as modified or supplemented hereinafter.
 - 2. Fire hydrants shall be 5-1/4 inch Mueller Super Centurion 200 with mechanical joint end inlet, or approved equal, as shown on the Drawings.
 - 3. Threads on nozzles and operating nut shall be National (American) Standard Fire Hose Coupling Screw Threads (per NFPA No. 194 and ANSI B26-1925, latest revision).
 - 4. Hydrants shall conform to the standards of the Texas Fire Insurance Commission.
- B. Valves, Fittings, etc.:
 - 1. Valves, fittings, etc., to be used in the completed installation shall be as specified in Section 33 12 16 - Water Utility Distribution Valves.
- C. Nozzles:
 - 1. Each hydrant shall be equipped with two (2) two and one-half inch (2 2") normal inside diameter hose nozzles and one (1) four inch (4") nominal inside diameter pumper nozzle conforming the National (American) Standard Fire Hose Coupling Screw Threads (per NFPA No. 194 and ANSI B26-1925, latest revision).
 - 2. Nozzles shall be securely fastened into the upper barrel by mechanical means, installed by turning counterclockwise, and shall be locked in place with a security device.
 - 3. Nozzle caps shall be furnished complete with rubber or neoprene gaskets and shall be securely attached to the hydrant barrel with chains of not less than one-eighth inch (1/8") diameter.
 - 4. The pumper nozzle shall be so situated as to allow an unobstructed radius of ten (10) inches from the threaded surface of the nozzle thought the path of travel of a wrench or other device used to fasten a hose to the nozzle.

- D. Each hydrant shall be equipped with an effective breakable hydrant barrel feature.
- E. Operating and Hold Down Nuts:
 - 1. The operating and hold down nuts shall be fabricated of stainless steel or of cast or ductile iron with bronze inserts or, in the alternative, a security device will be provided with each hydrant employing a bronze operating nut to protect this feature of each hydrant from malicious mischief or unauthorized removal. Any such security devices shall not require special tools for normal off/on operation of the hydrant.
 - 2. Hold down assemblies shall be fabricated of suitable metallic materials for the service intended.
- F. The inlet shall be a bell end connection designed for connection to a nominal six-inch (6") hub end, push-on, or mechanical joint assembly as specified in the bidding documents.
- G. Shut-off valve shall be of the Acompression type@ design, closing with the pressure, with center stem construction. The shut-off valve opening shall be circular and shall have a diameter of not less than five and one-quarter inches (5-1/4").
- H. The hydrant shall operate to open by turning to the left (counterclockwise).
- I. Valve Mechanism:
 - 1. The valve seat ring shall be constructed of bronze and shall be threaded into a bronze drain ring to provide an all bronzed drainway.
 - 2. The seat ring and main valve assembly shall be such that it can be removed from above ground through the upper barrel by means of a light-weight seat removal wrench.
 - 3. The valve seat facing shall be constructed of molded rubber having a Durometer rating of 90 \pm 5 and shall have a minimum thickness of one-half inch (2").
 - 4. The valve stem shall be provided with a breakable stem coupling opposite the barrel breakaway feature. Connecting pins and locking devices shall be constructed of bronze or other corrosion-resistant material. The valve stem shall be provided with a bronze sleeve, suitable AO-ring@ seals, and a travel stop.
 - 5. Operating threads and bearing surfaces shall be fully lubricated when opening or closing the main valve and shall be contained in a lubricating reservoir which is sealed at top and bottom.
 - 6. The operating assembly shall be provided with a thrust bearing or lubricated thrust collar to minimize operating torque.
- J. Hydrant Barrel:
 - 1. The lower hydrant barrel shall be fabricated as a single piece and shall be connected to the upper hydrant barrel by means of a joint coupling that will provide three hundred and sixty degree (360 \square) rotation of the upper barrel.
 - 2. The bury length shall be as specified and shall be the distance from the bottom of the inlet to the grounded line. The ground line shall be clearly marked on the barrel.
- K. A bronze or corrosion-resistant material lined drain opening shall be provided. Tapping of drain holes is not required. There shall be no springs, toggle joints, or intricate synchronizing mechanisms in proximity to the drain opening(s).
- L. All dynamic seals shall be of AO-ring@ type not requiring adjustment for a watertight seal; shall be of oil-resistant material; and all moving parts in contact with the seal shall be bronze or other corrosion-resistant material. Static seals shall be rubber, asbestos, or other approved composition.

- M. The hydrant barrel shall be designed to permit the use of one or more standard extensions, which shall be available from the hydrant manufacturer, in lengths from 6 inches to 60 inches in 6-inch increments.

2.2 PAINTING AND COATING

- A. Hydrants shall be shop coated with a suitable primer and finish painted in the following manner:

- 1. The hydrant barrel shall be painted blue using Texstar enamel or approved equal. The hydrant bonnet shall be painted reflective white with glass beads. The cap shall be painted using Texstar enamel or approved equal as follows:

| Line Size | Color of Bonnet and Caps |
|--------------------|--------------------------|
| 6-inch | Safety Yellow |
| 8-inch | Brilliant White |
| 10-inch and larger | Safety Green |

- 2. Surfaces below the bury line shall be coated with coal-tar enamel or asphalt-base bituminous coating material not less than one (1) mil thickness.
- 3. Interior surfaces below the main valve shall be coated with epoxy in conformance with AWWA C-550 (latest revision).

2.3 TESTING

- A. Certified fire hydrants shall comply with the performance standards as stated below. Compliance shall be determined through actual testing of each type or style of fire hydrant proposed for certification.

- 1. Hydraulic Performance Standards:

- a. Provide a discharge of 1,500 gpm or greater from the single pumper nozzle at a maximum permissible head loss of 8 psig for an inlet operating pressure of no more than 35 psig ± 2 psig.
- b. A certified pressure loss and quantity of flow test shall be conducted by a qualified testing laboratory on production model (five-foot bury length) of the hydrant (same catalog number) proposed for certification. This testing shall be conducted in strict accordance with AWWA standard C-502 (latest revision). A certified test report shall be submitted, and shall contain the following information:
 - 1) The date of test on a fire hydrant with similar hydraulic characteristics.
 - 2) The name, catalog number, place of manufacture, and date of production of the hydrant(s) tested.

- B. Traffic Impact Performance Standards:

- 1. Certified fire hydrants shall be equipped with a breakable barrel feature and breakable valve stem coupling such that vehicular impact will result in a clean break of the barrel and the valve stem at the breakable feature.
- 2. Upon impact, the hydrant shut-off valve will remain closed and tight against leakage.

3. Damage to the hydrant and appurtenances resulting in an estimated cost in excess of the one hundred dollars (\$100) for replacement breakable barrel feature parts or failure of the barrel to cleanly and completely break upon impact shall be cause for rejection of the hydrant.
- C. Traffic Impact Testing:
1. A certified test report shall be provided which outlines the results of a traffic impact test involving standard production models of the fire hydrant with a breakable barrel the same in design to that proposed for certification.
 2. These hydrants shall be installed in strict accordance with the requirements of AWWA Standards C-600 (latest revision) and shall be struck at a point 18 inches \pm 2 inches above the designated ground line.
 3. The proximate point of impact on the hydrant barrel shall be within two inches of the line perpendicular to the base and equidistant from the pumper nozzle and one hose nozzle.
 4. The intent of the traffic impact test will be to fulfill the following impact scenario through a mechanical impact test procedure approved in writing by the Engineer:
 - a. The point of impact on the vehicle front bumper shall be within six inches of a point equidistant for the midpoint of the bumper and the end point.
 - b. Impact velocity shall be 30 mph \pm 5 mph.
 - c. Successive tests shall be conducted to simulate an impact by standard American-made vehicles with net vehicle weights of 3000, 5000, and 10,000 pounds \pm 500 pounds.

PART 3 EXECUTION

3.1 CONSTRUCTION METHODS

- A. Allowable methods are specified as follows:
1. The setting of fire hydrants shall be performed in conformity with applicable portions of Section 33 11 00 - Water Utility Distribution Piping..
- B. Hydrants shall be placed at the locations shown on the Drawings and in conformity with details thereon, unless otherwise directed by the Owner=s Representative.
- C. Hydrants, valves, and valve boxes shall be set plumb with valve boxes placed directly over the valves after they have been completed.

END OF SECTION

SECTION 33 13 00 - DISINFECTING OF WATER UTILITY DISTRIBUTION

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Disinfection of potable water utility distribution piping.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices:
 - 1. No separate payment will be made for disinfection of water utility distribution under this Section. Include cost in unit price of water utility distribution piping being disinfected.
- B. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 REFERENCES

- A. AWWA C 651 - Standard for Disinfecting Water Mains.

PART 2 PRODUCTS -Not Used

PART 3 EXECUTION

3.1 CONDUCTING DISINFECTION

- A. Promptly disinfect water lines constructed before tests are conducted on water lines and before water lines are connected to Public water distribution system.
- B. Contractor shall provide water for disinfection at no additional charge to the Owner.
- C. Unless otherwise provided in Contract Documents, Contractor will conduct disinfection operations.
- D. Coordinate chlorination operations through Owner's Representative.

3.2 PREPARATION

- A. Provide temporary blind flanges, cast-iron sleeves, plugs, necessary service taps, copper service leads, risers and jumpers of sizes, location and materials, and other items needed to facilitate disinfection of new water lines prior to connection to Public water distribution system. Normally, each valved section of water line requires two each 3/4-inch taps. A 2-inch minimum blow-off is required for water lines up to and including 6-inch diameter.
- B. Use fire hydrants as blow-offs to flush newly constructed water lines 8 inch diameters and above. Where fire hydrants are not available on water lines, install temporary blow-off valves and remove promptly upon successful completion of disinfection and testing.
- C. Slowly fill each section of pipe with water in manner approved by Owner's Representative. Average water velocity when filling pipeline should be less than one foot per second and

shall not, under any circumstance, exceed 2 feet per second. Before beginning disinfection operations, expel air from pipeline.

- D. Backfill excavations immediately after installation of risers or blow-offs.
- E. Install blow-off valves at end of water line to facilitate flushing of dead-end water lines. Install permanent blow-off valves according to drawings.

3.3 DISINFECTION BY CONTRACTOR

- A. The following procedure will be used when disinfection by Contractor is required by Contract Documents:
 - 1. Use not less than 100 parts of chlorine per million parts of water.
 - 2. Introduce chlorinating material to water lines in accordance with AWWA C 651.
 - 3. After contact period of not less than 24 hours, flush system with clean water until residual chlorine is no greater than 1.0 parts per million parts of water.
 - 4. Open and close valves in lines being sterilized several times during contact period.
 - 5. If chemical compound is used for sterilizing agent, place in pipes as directed by Owner's Representative.

3.4 BACTERIOLOGICAL TESTING

- A. After disinfection and flushing of water lines, bacteriological tests will be performed by the governing agency or testing laboratory in accordance with Division 1. When test results indicate need for additional disinfection of water lines based upon Texas Department of Health requirements, assist Contractor shall provide additional disinfection operations at no additional cost to the Owner.

3.5 COMPLETION

- A. Upon completion of disinfection and testing, remove risers except those approved for use in subsequent hydrostatic testing, and backfill excavation promptly.

END OF SECTION

SECTION 33 13 00.10 - HYDROSTATIC TESTING OF PIPELINES

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Field hydrostatic testing of newly installed water pipelines.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices:
 - 1. No payment will be made for hydrostatic testing of pipelines under this Section. Include cost in unit price of pipelines being tested.
- B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

PART 2 PRODUCTS – Not Used

PART 3 EXECUTION

3.1 PREPARATION

- A. Disinfect water system pipelines prior to hydrostatic testing.
- B. Hydrostatically test newly installed water pipelines after disinfection, when required, and before connecting to Public water distribution system.
- C. Water for testing will be charged to Contractor in accordance with applicable Ordinances. Prior to hydrostatic testing, obtain a transient meter from the appropriate governing authority. Contractor shall pay all fees associated with transient meter.
- D. Test pipelines in lengths between valves, or plugs, of not more than 4,000 feet.
- E. Conduct hydrostatic tests in presence of Owner's Representative.

3.2 TEST PROCEDURES

- A. Furnish, install, and operate connections, pump, meter, and gages necessary for hydrostatic testing.
- B. Allow pipeline to sit minimum of 24 hours from time it is initially disinfected until testing begins, to allow pipe wall or lining material to absorb water. Periods of up to 7 days may be required for mortar lining to become saturated.
- C. For small diameter pipelines, expel air and apply minimum test pressure of 125 psi. For large diameter water lines, expel air and apply minimum test pressure of 150 psi.
- D. Begin test by 9:00 a.m. unless otherwise approved by Owner's Representative. Maintain test pressure for 8 hours. When large quantity of water is required to maintain pressure during test, discontinue testing until cause of water loss is identified and corrected.
- E. Keep valves inside pressure reducing stations closed during hydrostatic pressure test.

3.3 ALLOWABLE LEAKAGE FOR WATERLINES

- A. During hydrostatic tests, no leakage will be allowed for sections of water lines consisting of welded joints.
- B. Maximum allowable leakage for water lines with rubber gasketed joints: 3.19 gallons per inch nominal diameter per mile of pipe per 24 hours while testing.
- C. For meter run installation, when work cannot be isolated and line fails pressure test, visual inspection of work by Owner's Representative for leakage during pressure test may be used to fulfill requirements of this section.

3.4 CORRECTION FOR FAILED TESTS

- A. Repair joints showing visible leaks on surface regardless of total leakage shown on test. Check valves and fittings to ensure that no leakage occurs that could affect or invalidate test. Remove cracked or defective pipes, fittings, and valves discovered during pressure test and replace with new items.
- B. Owner's Representative may require failed lines to be disinfected after repair and prior to retesting. Conduct and pay for subsequent disinfection operations in accordance with requirements of Division 33. Pay for water required for additional disinfection and retesting.
- C. Repeat test until satisfactory results are obtained.

3.5 COMPLETION

- A. Upon satisfactory completion of testing, remove risers remaining from disinfection and hydrostatic testing, and backfill excavation promptly.

END OF SECTION

SECTION 33 31 00 - SANITARY UTILITY SEWERAGE PIPING

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Gravity sanitary sewers and appurtenances, including stacks and service connections.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices:
 - 1. Payment for pipe installation is on a linear foot basis. Measurement will be taken along the center line of the pipe from center line to center line of manholes. Payment will be made for each linear foot installed complete in place including sewer pipe, excavation, bedding, backfill and special backfill, shoring, earthwork, connections to existing manholes and pipe, stacks, cleanouts, accessories, and post TV inspection.
- B. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 SUBMITTALS

- A. Conform to requirements of Division 1.
- B. Submit proposed methods, equipment, materials, and sequence of operations for sewer construction. Plan operations to minimize disruption of utilities to occupied facilities or adjacent property.
- C. Test Reports: Submit test reports and inspection videos as specified in Part 3 of this Section. Video tapes become property of Owner.

1.4 QUALITY ASSURANCE

- A. Qualifications. Install sanitary sewer that is watertight both in pipe-to-pipe joints and in pipe-to-manhole connections. Perform testing in accordance with Division 33.
- B. Regulatory Requirements.
 - 1. Install sewer lines to meet minimum separation distance from potable water line, as scheduled below. Separation distance is defined as distance between outside of water pipe and outside of sewer pipe. When possible, install new sanitary sewers no closer to water lines than 9 feet in all directions. Where this separation distance cannot be achieved, new sanitary sewers shall be installed as specified in this section.
 - 2. Make notification to Owner's Representative when water lines are uncovered during sanitary sewer installation where minimum separation distance cannot be maintained.
 - 3. Lay gravity sewer lines in straight alignment and grade.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Inspect pipe and fittings upon arrival of materials at job site.

SANITARY UTILITY SEWERAGE PIPING

- B. Handle and store pipe materials and fittings to protect them from damage due to impact, shock, shear, or free fall. Do not drag pipe and fittings along ground. Do not roll pipe unrestrained from delivery trucks.
- C. Use mechanical means to move or handle pipe. Employ acceptable clamps, rope or slings around outside barrel of pipe and fittings. Do not use hooks, bars, or other devices in contact with interior surface of pipe to lift or move lined pipe.

PART 2 PRODUCTS

2.1 PIPE

- A. Provide piping materials for gravity sanitary sewers of sizes and types indicated on Drawings or as specified. No SDR allowed on 4" and smaller pipe.
- B. Reinforced concrete pipe is not acceptable.

2.2 PIPE MATERIAL SCHEDULE

- A. Unless otherwise shown on Drawings, use pipe materials that conform to requirements specified in Division 33.
- B. Where shown on Drawings, provide pipe meeting minimum class, dimension ratio, or other criteria indicated.
- C. Pipe materials other than those listed above shall not be used for gravity sanitary sewers.

2.3 APPURTENANCES

- A. Stacks. Conform to requirements of Division 33.
- B. Service Connections. Conform to requirements of Division 33.
- C. Roof, street or other type of surface water drains shall not be connected or reconnected into sanitary sewer lines.

2.4 BEDDING, BACKFILL, AND TOPSOIL MATERIAL

- A. Bedding and Backfill: Conform to requirements of Division 31.
- B. Topsoil: Conform to requirements of Division 32.

PART 3 EXECUTION

3.1 PREPARATION

- A. Prepare traffic control plans and set up street detours and barricades in preparation for excavation when construction will affect traffic. Conform to requirements of Division 1.
- B. Provide barricades, flashing warning lights, and warning signs for excavations. Conform to requirements of Division 1. Maintain barricades and warning lights where work is in progress or where traffic is affected by work.

- C. Perform work in accordance with OSHA standards. Employ trench safety system as specified in Division 31 for excavations over 5 feet deep.
- D. Immediately notify agency or company owning utility line which is damaged, broken or disturbed. Obtain approval from Owner's Representative and agency or utility company for repairs or relocations, either temporary or permanent.
- E. Remove old pavements and structures including sidewalks and driveways in accordance with requirements of Division 2.
- F. Install and operate dewatering and surface water control measures in accordance with Division 1.
- G. Do not allow sand, debris or runoff to enter sewer system.

3.2 DIVERSION PUMPING

- A. Install and operate required bulkheads, plugs, piping, and diversion pumping equipment to maintain sewage flow and to prevent backup or overflow. Obtain approval for diversion pumping equipment and procedures from Owner's Representative.
- B. Design piping, joints and accessories to withstand twice maximum system pressure or 50 psi, whichever is greater.
- C. No sewage shall be diverted into area outside of sanitary sewer.
- D. In event of accidental spill or overflow, immediately stop overflow and take action to clean up and disinfect spillage. Promptly notify Owner's Representative so that required reporting can be made to Texas Natural Resources Conservation Commission and Environmental Protection Agency by Owner's Representative.

3.3 EXCAVATION

- A. Earthwork. Conform to requirements of Division 31. Use bedding as indicated on Drawings.
- B. Line and Grade. Establish required uniform line and grade in trench from benchmarks identified by Owner's Representative. Maintain this control for minimum of 100 feet behind and ahead of pipe-laying operation. Use laser beam equipment to establish and maintain proper line and grade of work. Use of appropriately sized grade boards which are substantially supported is also acceptable. Protect boards and location stakes from damage or dislocation.
- C. Trench Excavation. Excavate pipe trenches to depths shown on Drawings and as specified in Division 31.

3.4 PIPE INSTALLATION BY OPEN CUT

- A. Install pipe in accordance with pipe manufacturer's recommendations and as specified in following paragraphs.
- B. Install pipe only after excavation is completed, bottom of trench fine graded, bedding material is installed, and trench has been approved by Owner's Representative.

- C. Install pipe to line and grade indicated. Place pipe so that it has continuous bearing of barrel on bedding material and is laid in trench so interior surfaces of pipe follow grades and alignment indicated. Provide bell holes where necessary.
- D. Install pipe with spigot ends toward downstream end of flow such that water flows into bell and out the spigot.
- E. Form concentric joint with each section of adjoining pipe so as to prevent offsets.
- F. Keep interior of pipe clean as installation progresses. Remove foreign material and debris from pipe.
- G. Provide lubricant, place and drive home newly laid sections with come-a-long winches so as to eliminate damage to sections. Install pipe to "home" mark where provided. Use of back hoes or similar powered equipment will not be allowed unless protective measures are provided and approved in advance by Owner's Representative.
- H. Keep excavations free of water during construction and until final inspection.
- I. When work is not in progress, cover exposed ends of pipes with approved plug to prevent foreign material from entering pipe.
- J. Where gravity sanitary sewer is to be installed under existing water line with separation distance of at least 2 feet and less than 9 feet, install new sewer pipe so that one full 18 foot long pipe is centered on water line crossing. Embed sewer pipe in cement stabilized sand for minimum distance of 9 feet on each side of crossing.
- K. Where gravity sanitary sewer is to be installed under existing water line with separation distance of less than 2 feet, install new sewer using pressure-rated pipe as shown on Drawings. Maintain minimum 6-inch separation distance.
- L. Where the length of the stub is not indicated, install the stub to the right-of-way line and seal the free end with an approved plug.

3.5 PIPE INSTALLATION OTHER THAN OPEN CUT

- A. For installation of pipe by augering, jacking, or tunneling, conform to requirements of specification sections on tunneling augering, jacking and microtunneling work as appropriate.

3.6 INSTALLATION OF APPURTENANCES

- A. Service Connections. Install service connections to conform to requirements of Division 33.
- B. Stacks. Construct stacks to conform to requirements of Division 33.
- C. Construct manholes to conform to requirements of Division 33 as applicable. Install frames, rings, and covers to conform to requirements of Division 33.

3.7 INSPECTION AND TESTING

- A. Visual Inspection: Check pipe alignment in accordance with Division 33.
- B. Mandrel Testing. Use Mandrel Test to test flexible pipe for deflection. Refer to Division 33.

- C. Pipe Leakage Test. After backfilling line segment and prior to tie-in of service connections, visually inspect gravity sanitary sewers where feasible, and test for leakage in accordance with Division 33. Maintain piezometer installed to conform with Division 1 until acceptance testing is completed.

3.8 BACKFILL AND SITE CLEANUP

- A. Backfill and compact soil in accordance with Division 31.
- B. Backfill trench in specified lifts only after pipe installation is approved by Owner's Representative.
- C. Repair and replace removed or damaged pavement, curbs, gutters, and sidewalks as specified in Division 32.
- D. Provide hydromulch seeding in areas of commercial, industrial or undeveloped land use over surface of ground disturbed during construction and not paved or not designated to be paved. Grade surface at uniform slope to natural grade as indicated on Drawings. Provide minimum of 4 inches of topsoil and apply hydromulch according to requirements of Division 32.
- E. Provide sodding in areas of residential land use over surface of ground disturbed during construction and not paved or not designated to be paved. Grade surface at uniform slope to natural grade as indicated on Drawings. Provide minimum of 4 inches of topsoil and sod disturbed areas in accordance with Division 32.

3.9 POST-INSTALLATION TELEVISION INSPECTION

- A. Prior to final acceptance of newly constructed gravity sanitary sewers, perform cleaning and closed-circuit television inspection. Cleaning shall include utilizing variable pressure water nozzles (3000 psi) and collection, removal, transportation and disposal of sand, debris, and liquid wastes to legal disposal sites.
- B. The Owner must be notified at least 24 hours prior to start time for video inspection. Owner or Owner's Representative must be present to witness video inspection.
- C. Select and use closed-circuit television equipment that will produce color video tape. Produce video tape using pan-and-tilt, radial viewing, pipe inspection camera that pans plus and minus 275 degrees and rotates 360 degrees. Use camera with accurate footage counter which displays on monitor exact distance of camera from starting manhole. Use camera with camera height adjustment so that camera lens is always centered at one-half inside diameter, or higher, in pipe being televised. Provide lighting system that allows features and condition of pipe to be clearly seen. Reflector in front of camera may be necessary to enhance lighting in dark or large diameter pipe.
- D. Perform television inspection of gravity sanitary sewers as follows:
 - 1. Videos shall pan beginning and ending manholes to demonstrate that debris has been removed. Camera operator shall slowly pan each service connection and where sewer transitions from one pipe material to another.
 - 2. Video tapes shall be continuous for pipe segments between manholes. Do not leave gaps in video taping of segment between manholes and do not show single segment on more than one video tape.
 - 3. No flow is allowed in gravity sanitary sewer while performing post-installation television inspection.

- E. Provide video tapes on CD in a format compatible with Windows Media Player. Two labels are required. Place one label on the case and the other on face of each CD. Permanently label each video tape with following information.

Face of CD

| |
|---|
| Wastewater File No.: _____ Contractor's Name: _____ Inspection Type: <input type="checkbox"/> Survey <input type="checkbox"/> Pre-Installation <input type="checkbox"/> Post-Installation Tape No.: _____ Date Televised: _____ Date Submitted: _____ Basin No.: _____ |
|---|

CD Case

| Manhole No. From | Manhole No. To | Pipe Diameter | Pipe Length | Street |
|------------------|----------------|---------------|-------------|--------|
| _____ | _____ | _____ | _____ | _____ |
| _____ | _____ | _____ | _____ | _____ |
| _____ | _____ | _____ | _____ | _____ |
| _____ | _____ | _____ | _____ | _____ |

- F. For each video tape provide completed TV Inspection Report, as attached at end of this section. TV Inspection Report is written/narrated log of pipe conditions and service connections, indexed to footage counter.
- G. Upon completion of video tape reviews by Owner's Representative, Contractor will be notified regarding final acceptance of sewer segment.

TELEVISION INSPECTION CODES

HEADER INFORMATION

| LOCATION | |
|-----------------|---------------------------|
| A | STREET ROW, HEAVY TRAFFIC |
| B | STREET ROW, LIGHT TRAFFIC |
| C | EASEMENT, POOR ACCESS |
| D | EASEMENT, GOOD ACCESS |
| E | PARKING LOT, POOR ACCESS |
| F | PARKIGN LOT, GOOD ACCESS |
| G | ALLEY, POOR ACCESS |
| H | ALLEY, GOOD ACCESS |
| I | OPEN AREA, POOR ACCESS |
| J | OPEN AREA, GOOD ACCESS |

SURFACE COVER

| | |
|---|---------------------|
| A | ASPHALT STREET |
| B | CONCRETE STREET |
| C | SHELL STREET |
| D | SIDEWALK |
| E | TREES/SHRUBS |
| F | CLOSE TO FENCE |
| G | OPEN AREA |
| H | MOVABLE BUILDING |
| I | UNMOVABLE BUILDING |
| J | OVERHEAD UTILITIES |
| K | WATERWAY OR RAILWAY |
| L | HIGHWAY OR RUNWAY |
| M | PIPE ABOVE GROUND |

PIPE TYPE

| | |
|-----|---------------------------------|
| ABS | ACRYLONITRILE BUTADIENE STYRENE |
| BRK | BRICK |
| CIP | CAST IRON PIPE |
| CMP | CORRUGATED METAL PIPE |
| CON | POURED IN PLACE CONCRETE |
| CPP | CURED IN PLACE PIPE |
| DIP | DUCTILE IRON PIPE |
| FRP | FIBERGLASS REINFORCED PIPE |
| PLP | PLASTIC LINE CONCRETE PIPE |
| PEP | POLYETHYLENE PIPE |
| PVC | POLYVINYLCHLORIDE PIPE |
| RCP | REINFORCED CONCRETE PIPE |
| RPM | REINFORCED PLASTIC MORTAR PIPE |
| RCP | REINFORCED CONCRETE PIPE |
| URC | UNREINFORCED CONCRETE PIPE |
| VCP | VITRIFIED CLAY PIPE |

JOINTS

| CODES | DESCRIPTION | USE IN |
|--------------|-----------------------|---------------|
| A (3) | RP JT > 90% CLEAR | MJ |
| B (6) | DRP JT 80 – 90% CLEAR | MJ |
| C (9) | DRP JT < 80% CLEAR | MJ |
| D (3) | SHF JT > 90% CLEAR | MJ |
| E (6) | SHF JT 80 – 90% CLEAR | MJ |
| F (9) | SHF JT < 80% CLEAR | MJ |
| G (1) | WD JT 2” – 3” | MJ |
| H (2) | WD JT 3” – 4” | MJ |
| I (3) | WD JT > 4” | MJ |
| J (2) | BRK JT – LIGHT | BJ |
| K (4) | BRK JT – MEDIUM | BJ |
| L (6) | BRK JT – HEAVY | BJ |
| N (0) | VISIBLE GASKET | MJ |
| O (0) | LEAKING AT JOINT | MJ |

LATERALS (L)

| CODES | DESCRIPTION |
|--------------|--------------------------|
| A (1) | PRT SER 0” – 1” |
| B (2) | PRT SER 1” – 2” |
| C (3) | PRY SER 2” – 3” |
| D (4) | PRT SER 3” + |
| E (5) | EFFECT E – SERVICE CONN. |
| F (6) | DEAD/UNUSED SERVICE |
| G (7) | FACTORY SERVICE |
| H (0) | PLUMBER SERVICE |

ROOTS (R)

| CODES | DESCRIPTION |
|--------------|--------------------|
| A (1) | ROOTS - LIGHT |
| B (2) | ROOTS - MEDIUM |
| C (3) | ROOTS – HEAVY |

DEBRIS (D)

| CODES | DESCRIPTION |
|--------------|--------------------|
| A | DEBRIS - LIGHT |
| B | DEBRIS - MEDIUM |
| C | DEBRIS - HEAVY |
| D | GREASE - LIGHT |
| E | GREASE - MEDIUM |
| F | GREASE – HEAVY |

INFLOW/INFILTRATION (I)

| CODES | DESCRIPTION |
|--------------|-----------------------------|
| A (3) | I/I – LIGHT (0-1 GPM) |
| B (6) | I/I – MEDIUM (1-5 GPM) |
| C (9) | I/I – HEAVY (> 5 GPM) |
| D (2) | I/I – SOME EVIDENCE |
| E (4) | I/I – CONSIDERABLE EVIDENCE |
| F (6) | I/I – GREAT EVIDENCE |
| G (0) | I/I – NO EVIDENCE |

WEATHER
 DRY - WET

CODE DESCRIPTIONS

CRACKS

RC-RADIAL LC-LONGITUDINAL

| CODES | DESCRIPTION | USE IN |
|--------------|----------------------|---------------|
| A (1) | < ½" W, 1' L | CRK |
| B (2) | < ½" W, 1' - 2' L | CRK |
| C (3) | < ½" W, >2' L | CRK |
| D (4) | > ½" W, < 1' L | CRK |
| E (5) | > ½" W, 1' - 2' L | CRK |
| F (6) | > ½" W, > 2' L | CRK |
| G (7) | HOLE IN PIPE - SMALL | |
| H (8) | PIPE MISSING - < 60° | |
| I (9) | PIPE MISSING - > 60° | |

ALIGNMENT (A)

| CODES | DESCRIPTION |
|--------------|-----------------------|
| A | BEGIN ¼ PIPE WATER |
| B | BEGIN ½ PIPE WATER |
| C | CAMERA UNDERWATER |
| D | END CAMERA UNDERWATER |
| E | END ½ PIPE WATER |
| F | END ¼ PIPE WATER |

STRUCTURAL

DS-DETERIORATED; OS-OVALITY; CS COLLAPSED

| CODES | DESCRIPTION | USE IN |
|--------------|--------------------|---------------|
| A (3) | LINE DET - LIGHT | DS |
| B (6) | LINE DET - MEDIUM | DS |
| C (9) | LINE DET - HEAVY | DS |
| D (3) | OVAL < 5% | OS |
| E (6) | OVAL > 5% & < 10% | OS |
| F (9) | OVAL > 10% | OS |
| G (9) | COLLAPSED | CS |
| H (0) | PIPE DET - HEAVY | DS |
| L (0) | PIPE DET - LIGHT | DS |
| M (0) | PIPE - MEDIUM | DS |
| N (0) | PIPE DET - NONE | DS |
| O | LINE DET - NONE | DS |
| Z (0) | AT MANHOLE NUMBER | CS |

END OF SECTION

SECTION 33 31 00.10 – ACCEPTANCE TESTING FOR SANITARY SEWERS

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Acceptance testing of sanitary sewers including:
 - 1. Visual inspection of sewer pipes.
 - 2. Mandrel testing for flexible sewer pipes.
 - 3. Leakage testing of sewer pipes.
 - 4. Leakage testing of manholes.
 - 5. Smoke testing of point repairs.
 - 6. All tests listed in this Section are not necessarily required on this Project. Required tests are named in other Sections which refer to this Section for testing criteria and procedures.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices:
 - 1. No payment will be made for acceptance testing under this Section. Include payment in unit price for work requiring acceptance testing.
- B. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 REFERENCES

- A. ASTM C 828 - Standard Test Method for Low Pressure Air Test of Vitrified Clay Pipe Lines.
- B. ASTM C 924 - Standard Practice for Testing Concrete Pipe Sewer Lines by Low-Pressure Air Test Method.
- C. ASTM D 3034 - Standard Specification for Type PSM Polyethylene (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
- D. ASTM F 794 - Specification for Poly (Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter.
- E. ASTM F 1417 - Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low Pressure Air.

1.4 PERFORMANCE REQUIREMENTS

- A. Gravity flow sanitary sewers are required to have straight alignment and uniform grade between manholes.
- B. Flexible pipe, including "semi-rigid" pipe, is required to show no more than 5 percent deflection. Test pipe no sooner than 30 days after backfilling of line segment but prior to final acceptance using standard mandrel to verify that installed pipe is within specified deflection tolerances.
- C. Maximum allowable leakage for Infiltration or Exfiltration.

1. The total exfiltration, as determined by hydrostatic head test, shall not exceed 50 gallons per inch diameter per mile of pipe per 24 hours at minimum test head of 2 feet above crown of pipe at upstream manhole or 2 feet above groundwater elevation, whichever is greater.
 2. When pipes are installed more than 2 feet below groundwater level, use infiltration test in lieu of exfiltration test. Total infiltration shall not exceed 50 gallons per inch diameter per mile of pipe per 24 hours. Groundwater elevation must be at least 2 feet above crown of pipe at upstream manhole.
 3. Refer to Table 33 31 00.10-1, Water Test Allowable Leakage, at end of Section, for measuring leakage in sewers. Perform leakage testing to verify that leakage criteria are met.
- D. Perform air testing in accordance with requirements of this Section and Texas Natural Resources Conservation Commission requirements. Refer to Table 33 31 00.10-2, Time Allowed for Pressure Loss from 3.5 psig to 2.5 psig, Table 33 31 00.10-3, Minimum Testing Times for Low Pressure Air Test, and Table 33 31 00.10-4, Vacuum Test Time Table, at end of this Section.

1.5 SUBMITTALS

- A. Conform to requirements of Division 1.
- B. Test Plan: Before testing begins and in adequate time to obtain approval through submittal process, prepare and submit test plan for approval by Owner's Representative. Include testing procedures, methods, equipment, and tentative schedule. Obtain advance written approval for deviations from Drawings and Specifications.
- C. Test Reports: Submit test reports for each test on each segment of sanitary sewer.

1.6 GRAVITY SANITARY SEWER QUALITY ASSURANCE

- A. Repair, correct, and retest manholes or sections of pipe which fail to meet specified requirements when tested.
- B. Provide testing reports and video tape of television inspection as directed by Owner's Representative.
- C. Upon completion of tape reviews by Owner's Representative, Contractor will be notified regarding final acceptance of sewer segment.

1.7 SEQUENCING AND SCHEDULING

- A. Perform testing as work progresses. Schedule testing so that no more than 1000 linear feet of installed sewer remains untested at one time.
- B. Coordinate testing schedules with Owner's Representative. Perform testing under observation of Owner's Representative.

PART 2 PRODUCTS

2.1 DEFLECTION MANDREL

- A. Mandrel Sizing. Rigid mandrel shall have outside diameter (O.D.) equal to 95 percent of inside diameter (I.D.) of pipe. Inside diameter of pipe, for purpose of determining outside diameter of mandrel, shall be average outside diameter minus two minimum wall thicknesses for O.D. controlled pipe and average inside diameter for I.D. controlled pipe, dimensions shall be per appropriate standard. Statistical or other "tolerance packages" shall not be considered in mandrel sizing.
- B. Mandrel Design. Rigid mandrel shall be constructed of metal or rigid plastic material that can withstand 200 psi without being deformed. Mandrel shall have nine or more "runners" or "legs" as long as total number of legs is odd number. Barrel section of mandrel shall have length of at least 75 percent of inside diameter of pipe. Rigid mandrel shall not have adjustable or collapsible legs which would allow reduction in mandrel diameter during testing. Provide and use proving ring for modifying each size mandrel.
- C. Proving Ring. Furnish "proving ring" with each mandrel. Fabricate ring of 1/2-inch-thick, 3-inch-wide bar steel to diameter 0.02 inches larger than approved mandrel diameter.
- D. Mandrel Dimensions (5 percent allowance). Average inside diameter and minimum mandrel diameter are specified in Table 30 31 00.10-5, Pipe vs. Mandrel Diameter, at end of this Section. Mandrels for higher strength, thicker wall pipe or other pipe not listed in table may be used when approved by Owner's Representative.

2.2 EXFILTRATION TEST

- A. Water Meter: Obtain transient water meter from appropriate governmental agency for use when water for testing will be taken from public system. Conform to governmental agency requirements for water meter use.
- B. Test Equipment:
 - 1. Pipe plugs.
 - 2. Pipe risers where manhole cone is less than 2 feet above highest point in pipe or service lead.

2.3 INFILTRATION TEST

- A. Test Equipment:
 - 1. Calibrated 90 degree V-notch weir.
 - 2. Pipe plugs.

2.4 LOW PRESSURE AIR TEST

- A. Minimum Requirement for Equipment:
 - 1. Control panel.
 - 2. Low-pressure air supply connected to control panel.
 - 3. Pneumatic plugs: Acceptable size for diameter of pipe to be tested; capable of withstanding internal test pressure without leaking or requiring external bracing.
 - 4. Air hoses from control panel to:
 - 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 length of pipe on ground. Pressurize plugs to 25 psig; then pressurize sealed pipe to 5 psig. Plugs are acceptable when they remain in place against test pressure without external aids.

2.5 GROUND WATER DETERMINATION

- A. Equipment: Pipe probe or small diameter casing for ground water elevation determination.

2.6 SMOKE TESTING

- A. Equipment:
1. Pneumatic plugs.
 2. Smoke generator as supplied by Superior Signal Company or approved equal.
 3. Blowers producing 2500 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 device necessary for proper testing and inspection.
- B. Determine selection of test methods and pressures for gravity sanitary sewers based on ground water elevation. Determine ground water elevation using equipment and procedures conforming to Division 1.

3.2 VISUAL INSPECTION OF GRAVITY SANITARY SEWERS

- 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.

3.3 MANDREL TESTING FOR GRAVITY SANITARY SEWERS

- A. Perform deflection testing on flexible and semi-rigid pipe to confirm pipe has no more than 5 percent deflection. Mandrel testing shall conform to ASTM D 3034. Perform testing no sooner than 30 days after backfilling of line segment, but prior to final acceptance testing of line segment.
- B. Pull approved mandrel by hand through sewer sections. Replace any section of sewer not passing mandrel. Mandrel testing is not required for stubs.
- C. Retest repaired or replaced sewer sections.

3.4 LEAKAGE TESTING FOR GRAVITY SANITARY SEWERS

A. Test Options:

1. Test gravity sanitary sewer pipes for leakage by either exfiltration or infiltration methods, as appropriate, or with low pressure air testing.
2. Test new or rehabilitated sanitary sewer manholes with water or low pressure air. Manholes tested with low pressure air shall undergo physical inspection prior to testing.
3. Perform leakage testing after backfilling of line segment, and prior to tie-in of service connections.
4. If no installed piezometer is within 500 feet of sewer segment, provide temporary piezometer for this purpose.

B. Compensating for Ground Water Pressure:

1. Where ground water exists, install pipe nipple at same time sewer line is placed. Use 1/2-inch capped pipe nipple approximately 10 inches long. Make installation through manhole wall on top of sewer line where line enters manhole.
2. Immediately before performing line acceptance test, remove cap, clear pipe nipple with air pressure, and connect clear plastic tube to nipple. Support tube vertically and allow water to rise in tube. After water stops rising, measure height in feet of water over invert of pipe. Divide this height by 2.3 feet/psi to determine ground water pressure to be used in line testing.

C. Exfiltration test:

1. Determine ground water elevation.
2. Plug sewer in downstream manhole.
3. Plug incoming pipes in upstream manhole.
4. Install riser pipe in outgoing pipe of upstream manhole when highest point in service lead (house service) is less than 2 feet below bottom of manhole cone.
5. Fill sewer pipe and manhole or pipe riser, when used, with water to point 2-1/2 feet above highest point in sewer pipe, house lead, or ground water table, whichever is highest.
6. Allow water to stabilize for one to two hours. Take water level reading to determine drop of water surface, in inches, over one-hour period, and calculate water loss (1 inch of water in 4 feet diameter manhole equals 8.22 gallons) or measure quantity of water required to keep water at same level. Loss shall not exceed that calculated from allowable leakage according to Table 33 31 00.10-1 at end of this Section.

D. Infiltration test: Ground water elevation must be not less than 2.0 feet above highest point of sewer pipe or service lead (house service).

1. Determine ground water elevation.
2. Plug incoming pipes in upstream manhole.
3. Insert calibrated 90 degree V-notch weir in pipe on downstream manhole.
4. Allow water to rise and flow over weir until it stabilizes.
5. Take five readings of accumulated volume over period of 2 hours and use average for infiltration. Average must not exceed that calculated for 2 hours from allowable leakage according to Table 33 31 00.10-1 at end of this Section.

E. Low Air Pressure Test: When using this test conform to ASTM C 828, ASTM C 924, or ASTM F 1417, as applicable, with holding time not less than that listed in Table 33 01 30-2.

1. Air testing for sections of pipe shall be limited to lines less than 36-inch average inside diameter.

2. Lines 36-inch average inside diameter and larger shall be tested at each joint. Minimum time allowable for pressure to drop from 3.5 pounds per square inch gauge to 2.5 pounds per square inch during joint test shall be 10 seconds, regardless of pipe size.
 3. For pipe sections less than 36-inch average inside diameter:
 - a. Determine ground water level.
 - b. Plug both ends of pipe. For concrete pipe, flood pipe and allow 2 hours to saturate concrete. Then drain and plug concrete pipe.
 - c. After manhole-to-manhole section of sanitary sewer main has been sliplined and prior to any service lines being connected to new liner, plug liner at each manhole with pneumatic plugs.
 - d. Pressurize pipe to 4.0 psig. Increase pressure 1.0 psi for each 2.3 feet of ground water over highest point in system. Allow pressure to stabilize for 2 to 4 minutes. Adjust pressure to start at 3.5 psig (plus adjustment for ground water table). See Table 33 31 00.10-2 at end of this Section.
 - e. To determine air loss, measure time interval for pressure to drop to 2.5 psig. Time must exceed that listed in Table 33 31 00.10-2 at end of this Section for pipe diameter and length. For sliplining, use diameter of carrier pipe.
- F. Retest: Repair and retest any section of pipe which fails to meet requirements.

3.5 TEST CRITERIA TABLES

- A. Exfiltration and Infiltration Water Tests: Refer to Table 33 31 00.10-1, Water Test Allowable Leakage, at end of this Section.
- B. Low Pressure Air Test:
 1. Times in Table 33 31 00.10-2, Time Allowed For Pressure Loss From 3.5 psig to 2.5 psig, at end of this Section, are based on equation from Texas Natural Resources and Conservation Commission (TNRCC) Design Criteria 317.2(a)(4)(B).

| | | |
|--------|-----|---|
| | | $T = 0.0850(D)(K)/(Q)$ |
| Where: | T = | Time for pressure to drop 1.0 pounds per square inch gauge in seconds |
| | K = | 0.000419 DL, but not less than 1.0 |
| | D = | Average inside diameter in inches |
| | L = | Length of line of same pipe size in feet |
| | Q = | Rate of loss, 0.0015 ft ³ /min./sq. ft. internal surface |

2. Since K value of less than 1.0 shall not be used, there are minimum testing times for each pipe diameter as given in Table 33 31 00.10-3, Minimum Testing Times for Low Pressure Air Test.

Notes:

1. When two sizes of pipe are involved, compute time by ratio of lengths involved.
2. Lines with 27-inch average inside diameter and larger may be air tested at each joint.
3. Lines with average inside diameter greater than 36 inches must be air tested for leakage at each joint.
4. If joint test is used, perform visual inspection of joint immediately after testing.
5. For joint test, pipe is to be pressurized to 3.5 psi greater than pressure exerted by groundwater above pipe. Once pressure has stabilized, minimum times allowable for pressure to drop from 3.5 pounds per square inch gauge to 2.5 pounds per square inch gauge shall be 10 seconds.

3.6 LEAKAGE TESTING FOR MANHOLES

- A. After completion of manhole construction, wall sealing, or rehabilitation, but prior to backfilling, test manholes for water tightness using hydrostatic or vacuum testing procedures.
- B. Plug influent and effluent lines, including service lines, with suitably-sized pneumatic or mechanical plugs. Ensure plugs are properly rated for pressures required for test; follow manufacturer's safety and installation recommendations. Place plugs minimum of 6 inches outside of manhole walls. Brace inverts to prevent lines from being dislodged when lines entering manhole have not been backfilled.
- C. Vacuum testing:
 - 1. Install vacuum tester head assembly at top access point of manhole and adjust for proper seal on straight top section of manhole structure. Following manufacturer's instructions and safety precautions, inflate sealing element to recommended maximum inflation pressure; do not over-inflate.
 - 2. Evacuate manhole with vacuum pump to 10 inches mercury (Hg), disconnect pump, and monitor vacuum for time period specified in Table 33 31 00.10-4, Vacuum Test Time Table.
 - 3. If drop in vacuum exceeds 1 inch Hg over specified time period tabulated above, locate leaks, complete repairs necessary to seal manhole and repeat test procedure until satisfactory results are obtained.
- D. Perform hydrostatic exfiltration testing as follows:
 - 1. Seal wastewater lines coming into manhole with internal pipe plug. Then fill manhole with water and maintain it full for at least one hour.
 - 2. The maximum leakage for hydrostatic testing shall be 0.025 gallons per foot diameter per foot of manhole depth per hour.
 - 3. If water loss exceeds amount tabulated above, locate leaks, complete repairs necessary to seal manhole and repeat test procedure until satisfactory results are obtained.

3.7 SMOKE TEST PROCEDURE FOR POINT REPAIRS

- A. Application: Perform smoke test to:
 - 1. Locate points of line failure for point repair.
 - 2. Determine when point repairs are properly made.
 - 3. Determine when service connections have been reconnected to rehabilitated sewer.
 - 4. Check integrity of connections to newly replaced service taps to liners and to existing private service connections.
- B. Limitations: Do not backfill service taps until completion of this test. Test only those taps in single manhole section at one time. Keep number of open excavations to minimum.
- C. Preparation: Prior to smoke testing, give written notices to area residents no fewer than 2 days, nor more than 7 days, prior to proposed testing. Also give notice to Police and Fire Departments 24 hours prior to actual smoke testing.
- D. Isolate Section: Isolate manhole section to be tested from adjacent manhole sections to keep smoke localized. Temporarily seal annular space at manhole for sliplined sections.
- E. Smoke Introduction:

1. Operate equipment according to manufacturer's recommendation and as approved by Owner's Representative.
 2. Conduct test by forcing smoke from smoke generators through sanitary sewer main and service connections. Operate smoke generators for minimum of 5 minutes.
 3. Introduce smoke into upstream and downstream manhole as appropriate. Monitor tap/connection for smoke leaks. Note sources of leaks.
- F. Repair and Retest: Repair and replace taps or connections noted as leaking and then retest. Taps and connections may be left exposed in only one manhole section at time. When repair or replacement, testing or retesting, and backfilling of excavation is not completed within one workday, properly barricade and cover each excavation as approved by Owner's Representative.
- G. Service Connections: On houses where smoke does not issue from plumbing vent stacks to confirm reconnection of sewer service to newly installed liner pipe, perform dye test to confirm reconnection. Introduce dye into service line through plumbing fixture inside structure or sewer cleanout immediately outside structure and flush with water. Observe flow at service reconnection or downstream manhole. Detection of dye confirms reconnection.

Table 33 31 00.10-1

WATER TEST ALLOWABLE LEAKAGE

| DIAMETER OF RISER OR STACK IN INCHES | VOLUME PER INCH OF DEPTH | | ALLOWANCE LEAKAGE* | |
|---|--------------------------|---------|---|-----------------------------|
| | INCH | GALLONS | PIPE SIZE IN INCHES | GALLONS/MINUTE PER 100 FEET |
| 1 | 0.7854 | .0034 | 6 | 0.0039 |
| 2 | 3.1416 | .0136 | 8 | 0.0053 |
| 2.5 | 4.9087 | .0212 | 13 | 0.0066 |
| 3 | 7.0686 | .0306 | 12 | 0.0079 |
| 4 | 12.5664 | .0306 | 15 | 0.0099 |
| 5 | 19.6350 | .0544 | 18 | 0.0118 |
| 6 | 28.2743 | .1224 | 21 | 0.0138 |
| 8 | 50.2655 | .2176 | 24 | 0.0158 |
| | | | 27 | 0.0177 |
| | | | 30 | 0.0197 |
| | | | 36 | 0.0237 |
| | | | 42 | 0.0276 |
| For other diameters, multiply square of diameters by value for 1" diameter. | | | Equivalent to 50 gallons per inch of inside diameter per mile per 24 hours. | |

* Allowable leakage rate shall be reduced to 10 gallons per inch of inside diameter per mile per 24 hours, when sewer is identified as located within 25-year flood plain.

Table 33 31 00.10-2

ACCEPTANCE TESTING FOR SANITARY SEWERS

| TIME ALLOWED FOR PRESSURE LOSS FROM 3.5 PSIG TO 2.5 PSIG | | | | | | | | | | | | | | |
|--|-----------|---------------------------|------------------------------|---|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Pipe Diam (in.) | Min. Time | Length For Min. Time (ft) | Time for Longer Length (sec) | Specification Time for Length (L) Shown (min:sec) | | | | | | | | | | |
| | | | | 100 ft | 150 ft | 200 ft | 250 ft | 300 ft | 350 ft | 400 ft | 450 ft | 500 ft | 550 ft | 600 ft |
| | | | | | | | | | | | | | | |

| | | | | | | | | | | | | | | |
|----|-------|-----|--------|------|------|------|-------|-------|-------|-------|-------|-------|-------|-------|
| 6 | 5:40 | 398 | 0.8548 | 5:40 | 5:40 | 5:40 | 5:40 | 5:40 | 5:40 | 5:42 | 6:25 | 7:07 | 7:50 | 8:33 |
| 8 | 7:33 | 298 | 1.5196 | 7:33 | 7:33 | 7:33 | 7:33 | 7:36 | 8:52 | 10:08 | 11:24 | 12:40 | 13:56 | 15:12 |
| 10 | 9:27 | 239 | 2.3743 | 9:27 | 9:27 | 9:27 | 9:54 | 11:52 | 13:51 | 15:50 | 17:48 | 19:47 | 21:46 | 23:45 |
| 12 | 11:20 | 199 | 3.4190 | 11:2 | 11:2 | 11:2 | 14:15 | 17:06 | 19:57 | 22:48 | 25:39 | 28:30 | 31:20 | 34:11 |
| 15 | 14:10 | 159 | 5.3423 | 0 | 0 | 0 | 22:16 | 26:43 | 31:10 | 35:37 | 40:04 | 44:31 | 48:58 | 53:25 |
| 18 | 17:00 | 133 | 7.6928 | 14:1 | 14:1 | 17:4 | 32:03 | 38:28 | 44:52 | 51:17 | 57:42 | 64:06 | 70:31 | 76:56 |
| 21 | 19:50 | 114 | 10.470 | 0 | 0 | 8 | 43:38 | 52:21 | 61:05 | 69:48 | 78:32 | 87:15 | 95:59 | 104:4 |
| 24 | 22:40 | 99 | 8 | 17:0 | 19:1 | 25:3 | 56:59 | 68:23 | 79:47 | 91:10 | 102:3 | 113:5 | 125:2 | 2 |
| 27 | 25:30 | 88 | 13.676 | 0 | 4 | 9 | 72:07 | 86:33 | 100:5 | 115:2 | 4 | 8 | 2 | 136:4 |
| 30 | 28:20 | 80 | 2 | 19:5 | 26:1 | 35:5 | 89:02 | 106:5 | 8 | 4 | 129:4 | 144:1 | 158:4 | 6 |
| 33 | 31:10 | 72 | 17.308 | 0 | 1 | 4 | 107:4 | 1 | 124:3 | 142:2 | 9 | 4 | 0 | 173:0 |
| | | | 9 | 22:4 | 34:1 | 45:3 | 4 | 129:1 | 9 | 8 | 160:1 | 178:0 | 195:5 | 5 |
| | | | 21.369 | 8 | 1 | 5 | | 7 | 150:5 | 172:2 | 6 | 5 | 3 | 213:4 |
| | | | 0 | 28:5 | 43:1 | 57:4 | | | 0 | 3 | 193:5 | 215:2 | 237:0 | 1 |
| | | | 25.856 | 1 | 6 | 2 | | | | | 5 | 8 | 1 | 258:3 |
| | | | 5 | 35:3 | 53:2 | 71:1 | | | | | | | | 4 |
| | | | | 7 | 5 | 4 | | | | | | | | |
| | | | | 43:0 | 64.3 | 86:1 | | | | | | | | |
| | | | | 6 | 8 | 1 | | | | | | | | |

Table 33 31 00.10-3
MINIMUM TESTING TIMES FOR LOW PRESSURE AIR TEST

| Pipe Diameter (inches) | Minimum Time (seconds) | Length for Minimum Time (feet) | Time for Longer Length (seconds) |
|------------------------|------------------------|--------------------------------|----------------------------------|
| 6 | 340 | 398 | 0.855 (L) |
| 8 | 454 | 298 | 1.520 (L) |
| 10 | 567 | 239 | 2.374 (L) |
| 12 | 680 | 199 | 3.419 (L) |
| 15 | 850 | 159 | 5.342 (L) |
| 18 | 1020 | 133 | 7.693 (L) |
| 21 | 1190 | 114 | 10.471 (L) |
| 24 | 1360 | 100 | 13.676 (L) |
| 27 | 1530 | 88 | 17.309 (L) |
| 30 | 1700 | 80 | 21.369 (L) |
| 33 | 1870 | 72 | 25.856 (L) |

Table 33 31 00.10-4
VACUUM TEST TIME TABLE

| DEPTH IN FEET | TIME IN SECONDS BY PIPE DIAMETER | | |
|---------------|----------------------------------|-----|-----|
| | 48" | 60" | 72" |
| 4 | 10 | 13 | 16 |
| 8 | 20 | 26 | 32 |
| 12 | 30 | 39 | 48 |
| 16 | 40 | 52 | 64 |
| 20 | 50 | 65 | 80 |
| 24 | 60 | 78 | 96 |
| * | 5.0 | 6.5 | 8.0 |

*Add T times for each additional 2-foot depth.
(The values listed above have been extrapolated from ASTM C 924-85)

Table 33 31 00.10-5
 PIPE VS. MANDREL DIAMETER

| Material and Wall Construction | Nominal Size (Inches) | Average I.D. (Inches) | Minimum Mandrel Diameter (Inches) |
|--------------------------------|-----------------------|-----------------------|-----------------------------------|
| PVC-Solid (SDR 26) | 6 | 5.764 | 5.476 |
| | 8 | 7.715 | 7.329 |
| | 10 | 9.646 | 9.162 |
| PVC-Solid (SDR 35) | 12 | 11.737 | 11.150 |
| | 15 | 14.374 | 13.655 |
| | 18 | 17.629 | 16.748 |
| | 21 | 20.783 | 19.744 |
| | 24 | 23.381 | 22.120 |
| | 27 | 26.351 | 25.033 |
| PVC-Truss | 8 | 7.750 | 7.363 |
| | 10 | 9.750 | 9.263 |
| | 12 | 11.790 | 11.201 |
| | 15 | 14.770 | 14.032 |
| PVC-Profile (ASTM F 794) | 12 | 11.740 | 11.153 |
| | 15 | 14.370 | 13.652 |
| | 18 | 17.650 | 16.768 |
| | 21 | 20.750 | 19.713 |
| | 24 | 23.500 | 22.325 |
| | 27 | 26.500 | 25.175 |
| | 30 | 29.500 | 28.025 |
| | 36 | 35.500 | 33.725 |
| | 42 | 41.500 | 39.425 |
| 48 | 47.500 | 45.125 | |
| HDPE-Profile | 18 | 18.000 | 17.100 |
| | 21 | 21.000 | 19.950 |
| | 24 | 24.000 | 22.800 |
| | 27 | 27.000 | 25.650 |
| | 30 | 30.000 | 28.500 |
| | 36 | 36.000 | 34.200 |
| | 42 | 42.000 | 39.900 |
| | 48 | 48.000 | 45.600 |
| | 60 | 60.000 | 57.000 |
| Fiberglass (Class SN 46) | 12 | 12.85 | 11.822 |
| | 18 | 18.66 | 17.727 |
| | 20 | 20.68 | 19.646 |
| | 24 | 24.72 | 23.484 |
| | 30 | 30.68 | 29.146 |
| | 36 | 36.74 | 34.903 |
| | 42 | 42.70 | 40.565 |
| | 48 | 48.76 | 46.322 |
| | 60 | 60.38 | 57.361 |

END OF SECTION

SECTION 33 41 00 - STORM UTILITY DRAINAGE PIPING

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. New storm sewers and appurtenances, modifications to existing storm sewer system and installation of roadside ditch culverts.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices:
 - 1. Payment for storm sewers is on a linear foot basis for each type and size of pipe installed. Measurement will be taken along the center line of the pipe from center line to center line of manholes or from end to end of culverts.
 - 2. No separate payment will be made for earthwork, connections to existing manholes and pipe, accessories, equipment, and execution required
 - 3. or incidental to storm sewer work. Include cost in unit price for sewer pipe.
- B. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 SUBMITTALS

- A. Conform to requirements of Division 1.
- B. Submit manufacturer's literature for product specifications and installation instructions.
- C. Submit proposed methods, equipment, materials, and sequence of operations for sewer construction. Plan operations to minimize disruption of utilities to occupied facilities or adjacent property.

1.4 QUALITY ASSURANCE

- A. The Condition for acceptance shall be watertight storm sewer that is watertight both in pipe-to-pipe joints and in pipe-to-manhole connections.
- B. Provide manufacturer's certification to Specifications.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Comply with manufacturer's recommendations.
- B. Handle pipe, fittings, and accessories carefully with approved handling devices. Do not drop or roll pipe off trucks or trailers. Do not use Materials cracked, gouged, chipped, dented, or otherwise damaged shall not be use materials for installation.
- C. Store pipe and fittings on heavy timbers or platforms to avoid contact with ground.
- D. Unload pipe, fittings, and appurtenances as close as practical to location of installation to avoid unnecessary handling.
- E. Keep interiors of pipe and fittings free of dirt and foreign matter.

- F. Store PVC pipe out of direct sunlight.

PART 2 PRODUCTS

2.1 PIPE

- A. Provide piping materials for storm sewers shall be of sizes and types specified unless otherwise indicated on Drawings.
- B. In diameters where material alternatives are available, provide pipe from single manufacturer for each pipe diameter, unless otherwise approved by Owner's Representative or otherwise shown on Drawings.
- C. Existing pipe that has been removed during construction cannot be reused.

2.2 PIPE MATERIAL SCHEDULE

- A. Storm Sewer Pipe: Use pipe materials that conforming to requirements specified in Division 33 and as shown on the Drawings.
- B. Driveway Culvert Pipe for Streets with Open Ditches: Use pipe materials that conforming to requirements specified Division 33 and as shown on the Drawings.
- C. Provide pipe meeting minimum class, dimension ratio, or other criteria indicated.
- D. Pipe materials other than those listed above shall not be used for storm sewers.

2.3 BEDDING, BACKFILL, AND TOPSOIL MATERIAL

- A. Bedding and Backfill Material: Conform to requirements of Division 31.
- B. Topsoil: Conform to requirements of Division 32.
- C. Use cement stabilized sand material for bedding and backfill in the pipe zone for all storm sewers.

PART 3 EXECUTION

3.1 PREPARATION

- A. Prepare traffic control plans and set up street detours and barricades in preparation for excavation when construction will affects traffic. Conform to requirements of Division 1.
- B. Provide barricades, flashing warning lights, and signs for excavations. Conform to requirements of Division 1. Maintain barricades and warning lights for streets and intersections while Work is in progress or where traffic is affected by Work.
- C. Immediately notify agency or company owning utility lines which are damaged, broken, or disturbed. Obtain approval from Owner's Representative and agency for repairs or relocations, either temporary or permanent.
- D. Remove old pavements and structures, including sidewalks and driveways in accordance with requirements of Division 2.
- E. Install and operate dewatering and surface water control measures in accordance with Division 1.

3.2 EXCAVATION

- A. Earthwork. Conform to requirements of Division 31. Use bedding as indicated on Drawings.
- B. Line and Grade. Establish required uniform line and grade trench from benchmarks identified by Owner's Representative. Maintain this control for minimum of 100 feet behind and ahead of pipe-laying operation. Use laser beam equipment to establish and maintain proper line and grade of Work. Or use of appropriately sized grade boards which are substantially supported.
- C. Trench Excavation. Excavate pipe trenches to level as indicated on Standard Details. Backfill excavation with specified bedding material to level of lower one-third of pipe barrel. Tamp and compact backfill to provide bedding at indicated grade. Form bedding foundation to minimum depth of one-eighth of pipe diameter, but not less than 6 inches.

3.3 PIPE INSTALLATION

- A. Install in accordance with pipe manufacturer's recommendations and as specified in this section.
- B. Install pipe only after excavation is completed, bottom of trench is shaped, bedding material is installed, and trench has been approved by Owner's Representative.
- C. Install pipe to line and grade indicated on Drawings. Place pipe so that it has continuous bearing of barrel on bedding material with no voids, and is laid in trench so interior surfaces of pipe follows grades and alignments indicated.
- D. Install pipe with bells of pipe facing upstream of anticipated flow.
- E. Form concentric joint with each section of adjoining pipe to prevent offsets.
- F. Place and drive home newly laid sections with a sling or come-a-long winches to eliminate damage to sections. Unless otherwise approved by Owner's Representative, provide end protection to prevent damage while using back hoes or similar powered equipment to drive home newly laid sections.
- G. Keep interior of pipe clean as installation progresses.
- H. Keep excavations free of water during construction and until final inspection.
- I. When work is not in progress, cover exposed ends of pipes with pipe plug specifically designed to prevent foreign material from entering pipe.
- J. For PVC Pipe:
 - 1. Provide a minimum cover as per manufacturer's requirements from top of pavement to top of pipe, but no less than 2 feet.
 - 2. Accomplish transitions to different material of pipe in a manhole or inlet box. No adapter, coupling for dissimilar pipe, or saddle connections allowed.
 - 3. Provide pipe sections in standard lengths with minimum length of 13 feet. Pipe may be field modified to shorten length no less than 4 feet, unless otherwise approved by Owner's Representative. Field modify pipe per manufacturer's recommendations.
 - 4. No beveling at joint allowed. Cut to be perpendicular to longitudinal axis.
 - 5. Provide gasketed bell and spigot joints installed per manufacturer's recommendations. Gasketed pipe joints; clean and free of debris, show no leakage after installation.

3.4 PIPE INSTALLATION OTHER THAN OPEN CUT

- A. Conform to requirements of Division 33 where required.
- B. Not allowed for plastic sewer pipe.

3.5 INSTALLATION OF APPURTENANCES

- A. Construct manholes to conform to requirements of Division 33. Install frames, grate rings, and covers to conform to requirements of Division 33.
- B. Install PVC pipe culverts with approved end treatments. Approved end treatments include concrete headwalls, wingwalls and collars.
- C. Install inlets, headwalls, and wingwalls to conform to requirements of Division 33.
- D. Rehabilitate existing manholes to conform to requirements of Division 33. Adjust manhole covers and inlets to grade conforming to requirements of Division 33.
- E. Dimension for Type C and Type E manholes shall be as shown on Drawings.

3.6 INSPECTION AND TESTING

- A. Perform post installation television inspection in accordance with Division 33. Hand held cameras may be used in storm sewers in lieu of requirements Division 33. Clearly stencil distance markings on each joint of pipe to indicate distance from starting manhole when using hand held cameras.

3.7 BACKFILL AND SITE CLEANUP

- A. Backfill trench after pipe installation is inspected and approved by Owner's Representative.
- B. Backfill and compact soil in accordance with Division 31.
- C. Repair and replace removed or damaged pavement and sidewalks as specified in Division 32.
- D. In unpaved areas, grade surface as uniform slope to natural grade as indicated on Drawings. Provide minimum of 4 inches of topsoil and seed according to requirements of Division 32 as required.

END OF SECTION

SECTION 33 49 13 - STORM DRAINAGE MANHOLES, FRAMES AND COVERS

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Iron castings for manhole frames and covers, inlet frames and grates, catch basin frames and grates, meter vault frames and covers, adjustment rings, and extensions.
- B. Ring grates.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices:
 - 1. No payment will be made for frames, grates, rings, covers, and seals under this Section. Include payment in unit price for related item.
- B. Stipulated Price (Lump Sum). Contract is a Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 REFERENCES

- A. AASHTO -American Association of State Highway and Transportation Officials Standard Specification for Highway Bridges
- B. ASTM A 48 -Standard Specification for Gray Iron Castings
- C. ASTM A 615 -Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
- D. AWS -D 12.1 Welding Reinforcing Steel.

1.4 SUBMITTALS

- A. Conform to requirements of Division 1.
- B. Submit copies of manufacturer's specifications, load tables, dimension diagrams, anchor details, and installation instructions.
- C. Submit shop drawings for fabrication and installation of casting assemblies that are not included in Drawings or standard City details. Include plans, elevations, sections and connection details. Show anchorage and accessory items. Include setting drawings for location and installation of castings and anchorage devices.

PART 2 PRODUCTS

2.1 CASTINGS

- A. Use castings for frames, grates, rings and covers conforming to ASTM A 48, Class 35B. Provide locking covers if indicated on Drawings.
- B. Use clean castings capable of withstanding application of AASHTO M306-40,000 pound proof loading without detrimental permanent deformation.

- C. Fabricate castings to conform to shapes, dimensions, and with wording or logos shown on Drawings. Standard dimensions for manhole covers are 32 inches in diameter.
- D. Use clean castings, free from blowholes and other surface imperfections. Use clean and symmetrical cast holes in covers, free of plugs.

2.2 BEARING SURFACES

- A. Machine bearing surfaces between covers or grates and their respective frames so that even bearing is provided for position in which casting may be seated in frame.

2.3 SPECIAL FRAMES AND COVERS

- A. Where indicated on Drawings, provide watertight manhole frames, and covers with minimum of four bolts and gasket designed to seal cover to frame. Supply approved watertight manhole covers and frames.
- B. Where shown on Drawing, provide manhole frames and covers with 48 inch diameter clear opening, with inner cover for 22 inch diameter clear opening. Provide approved inner cover with pattern shown on Drawings.

2.4 FINISH

- A. Unless otherwise specified, uncoated cast iron.

2.5 FABRICATED RING GRATE

- A. Fabricate ring grates from reinforcing steel conforming to ASTM A 615.
- B. Conform to welds connecting bars to AWS D 12.1.

2.6 ADJUSTMENT RINGS FOR ASPHALT OVERLAYS

- A. Use castings conforming to Division 33 requirements.
- B. One piece casting with dimensions to fit frame and cover.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install castings according to approved shop drawings, instructions in related specifications, and applicable directions from manufacturer's printed materials.
- B. Set castings accurately at required locations to proper alignment and elevation. Keep castings plumb, level, true, and free of rack. Measure location accurately from established lines and grades. Brace or anchor frames temporarily in form work until permanently set.
- C. Fabricate ring grates in accordance with City of Houston standard detail, "Ring Grate for Open End of 18 Inch to 72 Inch Stubs to Ditch". Set in mortar in mouth of pipe bell.
- D. Install adjustment rings in existing frames with clean bearing surfaces that are free from rocking.

END OF SECTION